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[OFFICIAL NOTICE.]

## Sixth Annual Meeting, Pacific Coast Gas Association.

OFFICE OF THE SECRETARY, OAKLAND, CAL., June 6, 1898.

The sixth annual convention of the Pacific Coast Gas Association, Mr. F. H. Eichbaum, President, will be held in San Francisco, on Tuesday and Wednesday, July 19 and 20, 1898, in the office building of the San Francisco Gas and Electric Company; morning sessions, from 10:15 to 12:30; afternoon sessions, 2 to 4:30. The Board of Directors will meet on Monday, July 18, at 8 P.M., at headquarters, which are hereby established at office of Mr. E. C. Jones, Chief Engineer San Francisco Gas and Electric Company, No. 413 Post street.

Copies of all papers, questions and applications for membership must be mailed to Secretary prior to July 18. Members to whom questions are assigned are requested to send answers promptly.

Papers will be submitted by the following members, on subjects to be announced:

E. C. Jones, San Francisco, Cal.; C. O. Poole, San Francisco, Cal.; John L. Howard, San Francisco, Cal.; O. M. Gregory, San Jose, Cal.; F. Foveaux, San Francisco, Cal.; John A. Britton, Oakland, Cal.; W. M. Parker, Bellingham Bay, Wash.; A. Gutsch, Fresno, Cal. In addition to his address as President, Mr. Eichbaum will continue his "Reminiscences."

The question of the change of name of the Association, from that of the Pacific Coast Gas Association to that of the Pacific Coast Gas and Electric Association, will come up for final action.

Mr. George H. Hollidge, of Merced, Cal., has charge of "Wrinkles," and Mr. John Clement, of Red Bluff, Cal., is directing the "Experiences." It is hoped the members will contribute liberally to both of these departments.

An excursion is arranged for Thursday, July 21, particulars of which will be hereafter announced.

The Secretary has on hand a number of bound copies of the "Proceedings," which are purchasable at $2 per copy.

JOHN A. BRITTON, Secretary.

[OFFICIAL NOTICE.]

## Wrinkle Department, Pacific Coast Gas Association.

MERCED, CAL., March 11, 1898.

*To the Members of the Pacific Coast Gas Association:* At the last meeting of the Pacific Coast Gas Association to me was delegated the duty of collecting and presenting any matter, in the shape of original ideas or special devices, which may come under the head of "Wrinkles," to be presented in proper form for the benefit of the Association at the next regular assembly.

Many of our members having charge of gas plants on the Coast have many plans, that are practical, handy and labor-saving, which many others by force of circumstances have never seen, but who, on presentation of the device, drawn and described, or through the medium of our official organ (the AMERICAN GAS LIGHT JOURNAL), would gladly embrace the opportunity, and put into practice a plan very beneficial—which perhaps had been in use in some obscure place many years, used

exclusively by one man—that would, when given daylight, benefit the whole gas fraternity.

On reading this communication, please see if you have not forgotten something in the shape of a "Wrinkle," that is doing good service in your works, that would be of great importance to the Association. Your answer to this will greatly oblige. GEO. H. HOLLIDGE,
Editor "Wrinkle" Department.

## BRIEFLY TOLD.

THE LATEST CHAPTERS, BY VIVIAN B. LEWES, F.I.C., ETC., IN RESPECT TO THE MODERN DEVELOPMENTS OF ACETYLENE.—The Incorporated Gas Institute held its Thirty-fifth Annual General Meeting, June 21–23 last, in Exhibition Hall, Belfast, Ireland, with Mr. James Stelfox, presiding. From whatever point of view one reviews the meeting, the verdict must be handed in that it was a complete success. The paper list was long, but the topics were so cleverly written up by their authors, that the themes of themselves, rounded out by the intelligent discussions they provoked, caused the technical side of the meeting to be anything than dull. The social phases of the assembly were harmonious, happy and enjoyable; and, take it all-in-all, the Incorporated Gas Institute membership may not be other than congratulated on their whole work during the term that marked the Institute's attainment of 50 per cent. of the three-score-and-ten limit. A feature of the meeting, of course, was the "lecture," on the second day, by Professor Vivian B. Lewes, F.I.C., etc., who recurred for his subject to the matter of acetylene, although this time he selected to detail its latest developments; which, of course, was eminently proper. The "Chief Superintending Gas Examiner to the Corporation of the City of London"—for that title rightfully is included in the "etc." which usually accompanies his name when it appears in print—has had much to say about calcic carbide and the resultant gas that follows its contact with water; and the first of his chapters thereon (in the shape of a communication to the Society of Arts—London, Jan. 16th, 1895) we have held were responsible for much of the gain that came to the earliest speculators in the calcium carbide industry. During the course of his first carbide prospectus Prof. Lewes remarked: "At the present time, private information from America shows that calcic carbide can be produced at a little under $20 a ton, and the beautifully pure lime obtained by the decomposition would be worth at least $2.50 a ton, and as a ton of the carbide will give rather more than 1¼ tons of quicklime or 1¾ tons of slaked lime, $17.50 may be taken as the cost of the acetylene produced from a ton of the material, and will leave a margin for handling." So much for the first estimate of Prof. Lewes. Having felt winter merge into spring, and spring pass into summer, the Professor, at the 1895 meeting of the Incorporated Gas Institute, "lectured" that body on "Acetylene and the Part it Plays in the Luminosity of Flame." In the course of that lecture, referring to the cost per ton of calcic carbide, he remarked: "I have information which I believe to be reliable, to the effect that in Germany the carbide is being made at 170 marks, or practically $42.50 per ton, and experiments carried out in England point to the possibility of making it in bulk at $47.50 per ton. * * * Looking at these facts, I think it will be safe to say that the cost of making it will be between $40 and $60 per ton, and the selling price will be between $50 and $70 per ton." Now, in 1898, he returns to the estimating point—again before the Incorporated Gas Institute—in the lines of which "lecture" he declares: "In practically considering the price of carbide and the cost of acetylene, it is useless to take into account any other factor than the price at which carbide can be bought in bulk; and this is £16 a ton at the carbide works, which probably means £20 delivered in most localities." In that conclusion the Professor is amply supported by the latest pamphlet issued by the "Acetylene Illuminating Company, Limited," of the "Falls of Foyers, Scotland," and of "Victoria street, London." This Company, which is the largest manufacturer of carbide of calcium in Great Britain, declares: "The wholesale price of carbide, as at present quoted by this Company, is £20 per ton at Foyers, special terms being made to the trade for important contracts." Of course, we know that the test of time tells things truest, and we also know that some must lead that others may follow; but would it not be best that professional men of the stamp or reputation of Prof. Lewes assumed a middle course rather than that an early prediction of their's should enable conscienceless promoters to "skin the lamb?"

NOTES.—Mr. J. D. McCollum has accepted a responsible position with the Los Angeles (Cal.) Company.——The latest ridiculous proposition is that to establish a Company in opposition to the Cicero Gas Company, of Oak Park, Ills.

## Observations upon the Construction and Working of Inclined Retorts.

[A paper prepared by MR. E. DROBY, of Berlin, Germany, for the 8th Meeting of the English Institution of Gas Engineers.]

Although much has already been written about inclined retorts, their installation, cost of working, etc., the author ventures to communicate some information on this subject, which, drawn from Continental experience, and representing Continental views, may not be without interest.

At Berlin, 26 furnaces with inclined retorts were erected in the course of last summer, and all but two furnaces were brought into action last winter. Each setting contains 9 retorts, 15½ feet long. Unfortunately, neither in Vienna nor in Berlin did the circumstances permit the erection of new retort houses, specially designed for inclined retorts; and the existing ones, originally built for horizontals, offer by no means favorable conditions, either for ventilation or the manipulation of coal and coke. At Berlin, in spite of these drawbacks, a saving in wages of 1s. 8½d. per ton of coal, or about £5,000 per annum, was effected, as well as economizing nearly the same amount in fuel. A return of 20 per cent. on the capital expended on these benches may, therefore, be looked for. The average production of gas per retort and per day was 12,700 cubic feet with Durham coal, and 14,000 cubic feet with an addition of 15 per cent. of Silesian coal—the duration of charge being 4 hours 48 minutes. It is not necessary to enter further into the detals of working results and economy, as the cost of labor and materials, and the conditions of working on the Continent differ so entirely from those in England that a comparison is hardly possible.

The following remarks are restricted to the actual working and construction of inclined retorts, and embody the author's experience of nine years. One principle adopted was the avoidance of all expense beyond that strictly necessary to secure good and reliable work; but, on the other hand, there was free expenditure, where the prospect of economy in labor seemed to justify the capital outlay.

1. *Manipulation of Coal.*—On a works where the slopers form the total, or a considerable part of the gas producing plant, it is advisable, for the sake of security, to have the engines, coal crushers and elevators in duplicate. Where there are two parallel rows of benches (as at Berlin), the engines should be placed in a central position, so that one or either is able to drive one or either crusher and elevator, and these latter able to feed either row of benches. Many engineers will feel quite safe with a single set of apparatus, merely having duplicate pieces of the movable parts of the machinery in stock. Once in Vienna the steam engine driving a coal crusher broke down in such a manner that repair *in situ* was not possible. The consequence was that the whole machinery had to be put out of action for a fortnight. A similar accident might occur anywhere, and unexpectedly (accidents being usually of this kind), either to the engines or elevators, which are the parts of the greatest importance.

Two systems of coal crushers are in use at Berlin and Vienna—viz., with rollers and with jaws respectively. These latter have proved themselves preferable, as they will crush any sort of coal, including the hard Continental and cannel, with almost equal ease, which cannot be said of the roller crusher. One jaw crusher at Berlin disposes of more than one ton of coal a minute.

There are also two systems of elevators, the bucket elevator and the hydraulic lift for coal trucks. Where the coal has to be broken, the first one seems to be the handier, as it will automatically draw away the broken coal from under the crusher.

Coal hoppers have been provided above and along the whole length of the benches. The outlay entailed by this arrangement has been considered too high by some Continental engineers; but it is soon repaid by the economy in labor—the transport of coal in front of the hot furnaces being avoided. For delivering the coal into the hoppers (in Vienna and Berlin) conveyors have been used, as well as trucks running on rails. There is little doubt that a conveyor is the more suitable of the two, and does not necessitate heavily constructed hoppers to carry the rails and trucks, nor require so many men to work it. All the mechanical appliances for coal have proved very reliable, and the wear and tear on them is moderate.

2. *Charging of Retorts.*—When the coal falls from the conveyor into the hopper, it forms into heaps, on the sides of which the large lumps tumble down; the fine coal remaining in the middle. The coal in the hopper, therefore, varies in size. Supposing the charging apparatus to be perfectly automatic, it would require to be continually adjusted to suit the different sizes of coal; and this would be, to say the least, difficult. The author, therefore, does not make his charging ap-

paratus of the completely automatic type, but relies to a certain extent on the intelligence of the workman. This man, standing on an elevated platform, has all three rows of retorts well under his observation, and can easily control the charging, and after the carbonization is complete, observe the layer of coke in the retorts. The shoots, which are lifted into the mouthpieces by means of a lever, are made at such an angle that coal of average size will just charge the retorts properly from top to bottom. Such regulating as is necessary is done by the workman with a horizontal slide valve fixed between the measuring chamber and the shoot. With a little practice, a man will get so accustomed to this regulating work, that he will charge one hour English coal, the next Silesian coal, and the next again Westphalian coal with equal ease.

It is not desirable that one and the same amount of coal be charged in every retort *coûte qu'il coûte*. Large and dry coal runs down quickly and carbonizes easily; and a heavier charge is necessary than in the case of fine and wet coal. In every case the retorts receive the charge of coal necessary to fill them up to the top. It would appear that the difficulty in England is to make the stoker charge a sufficiently large quantity of coal. This is certainly not so either in Germany or Austria. The men retain so much of the discipline of their military service that, as a rule, they do their work conscientiously, especially if there is a good foreman; and as only a few men are required for charging, it is easy to select the pick of the yard for this purpose.

3. *Manipulation of Coke.*—The successful economical working of an installation of slopers depends in a great measure on the ease with which the discharging can be done, and the coke disposed of. Different sorts of coal give sometimes very varying results. Silesian and Moravian coal does not swell during carbonization, and the coke slides out easily when slightly pushed from above. Several coals of the Durham district do not give much trouble either, although they swell during carbonization, whereas others make a deal of pricking up from below necessary. The same trouble was experienced with Westphalian coal. As this difficulty cannot well be overcome, there is all the more reason for making the quenching and disposing of the coke as perfect as possible.

Where the working floor of the retort house is on the ground level, and the coke quenched where it falls, the men are greatly hindered by the heaps of coke. On the other hand, where there is a stage floor, and the coke falls through openings into trucks and is quenched therein, they suffer considerably from the steam and smoke, both above and below. Indeed, the men protested against this method in Berlin. It also entails a considerable amount of labor, as the trucks have to keep pace with the rapid discharging of the retorts. The system which appears best adapted to avoid these drawbacks is the "De Brouwer trough," which is at work at Bruges and the Hague, and is in course of installation at Cassel and Charlottenburg, near Berlin. The conveyor in the trough takes away the coke to the heap automatically, quenching it gradually on the way, and sending up the vapor near the front of the benches. Consequently the work at the retorts can be proceeded with without hindrance or interruption.

4. *The Retort House.*—The construction of the retort house is also a matter of great importance. There is no doubt that considerable economy can be realized, and much can be done for the general comfort of the men, if, instead of the old-fashioned retort house, a construction were attempted somewhat better adapted to the peculiar working conditions of the inclined retorts. This is by no means an easy task, for the human mind clings persistently to the customary and the conventional, and needs time to find the form adequate to the new idea.

The chief thing is to know clearly the main features desirable in a retort house for inclined retorts. The author's objects in this respect were simply these: Protection against wind and rain for the furnaces; protection against heat, smoke and vapors for the men. Obviously, these aims are nearest attained the closer the roof and walls approach the furnaces, and consequently, the nearer the men get to the open air. The design of the retort house now to be described is a result of the above train of ideas.

The two rows of furnaces, 30 feet apart, and the elevated sides face to face, form, together with the gable walls, a kind of open courtyard. The men on the top of the stage floor, who have a good deal to suffer from the heat (being obliged to stand rather close to the furnace) are thus protected against wind, but have plenty of fresh air. On the lower side of the furnaces, above the bottom stage floor, the retort house walls (iron girders in concrete) are built at a distance of only 4 feet from the furnaces. Sliding doors are provided in front of the retorts, which are pushed aside during the time of discharging. The men, who have no particularly hard work to do, are practically as much in the open air as their comrades in the coal or coke yard, and much prefer this to the smoky retort house. In Vienna a small roof was at first erected, to protect them against snow and rain; but the men soon found that they were much better off in the open air, and asked to have it taken away, which was done. Since then they have worked there several winters and summers with satisfaction. Frost can do no harm, there being no hydraulic machinery to be effected by it; and in the event of a very heavy rain the charges may be postponed for a quarter of an hour.

In the highest part of the roof, just above the low side of the furnace, an aperture is left, 6 feet wide, the whole length of the bench, which, acting as a chimney, will easily draw away the vapors, as well of the top as of the bottom mouthpieces. At Berlin, where the slopers are built in an old retort house with a semicircular roof, the top of which forms the center line of the two rows of benches, the vapors from the furnace stream across the top stage towards the middle, to the great inconvenience of the men.

It is evident that a retort house especially designed for slopers cannot cost much. The covered area is but small; walls and roof, very light; and foundations, next to nothing. This fact can but favorably affect the original outlay for slopers as compared with other systems of gas production.

5. *Furnace.*—The adoption of a generator is necessary for a furnace with inclined retorts. The simple fire bar system is not to be recommended, as no uniform heat is obtainable thereby, especially with retorts 15 or 20 feet in length. Particular care must be taken in the construction of the setting, as well as of the stays for keeping it in its position. The retorts, the generator and the regenerator should have separate stays.

It is also very essential that the fuel gas leaves the generator at as low a temperature as possible, so that the arches which have to carry the weight of the setting should not suffer too much. For this it is necessary always to keep a uniform layer of 4 to 5 feet of fuel; to keep the generator perfectly tight, so that no air can enter through a leak and cause combustion in the wrong place; and to evaporate about 1 pound of water under the fire bars per pound of coke used as fuel.

If the combustion is a dry one, the gaseous fuel leaves the generator at a temperature of about 2,500° F. If a sufficient quantity of water is evaporated, this temperature will be only 1,800° F. In the latter case, moreover, the slag is quite soft, so that the fire bars only want cleaning once in 48 hours. The opening through which the generator is fed must be as large as a retort mouthpiece, in order to get the large lumps of coke easily through. The regenerator must be of such ample construction that the heated air leaves the last flue at a temperature of 1,600° F., and the waste gases must not have more than 900° F. when entering the chimney.

As to the interior of the setting, the supports which carry the retorts should not be more than 8 inches apart, as otherwise the retorts are liable to crack; and the joints of the retort lengths should be perpendicular, so that they just come in the middle of a support.

The correct distribution of the heat is of the greatest importance. The retorts should not be too hot in one part, especially near the bottom mouthpiece, as otherwise stopped ascension pipes and thick tar in the hydraulic main will be the result. A uniform heat is secured by covering up 6 inches of the intermediate spaces of 8 inches between the supports on the level of the upper retorts. By these means a slight pressure is obtained in the furnace, resulting in a uniform distribution of the fuel gas through the relatively small apertures. This is on much the same principle as the rose of a watering pot, which with a high pressure and numerous small holes gives off a uniform distribution of the water, whereas one with relatively large holes and low pressure gives it off in an irregular way. Apart from this, there is a damper in the main flue leading from the generator to the furnace, which allows the fuel gas to be forced either more towards the upper or lower parts, as may be necessary according to the sort of coal used.

6. *Quality of the Gas.*—The illuminating power of the gas produced with slopers of 15½ feet length is the same as that produced with horizontals 8 feet long.

7. *Advantages of the System.*—Inclined retorts have the advantage of being able to produce gas of good quality and in large quantities on a small area of ground. They effect considerable economy in labor. In a modern, well ventilated retort house, provided with a De Brouwer's trough, certainly not more than five men are necessary for working 180 mouthpieces, including charging and discharging of retorts, and quenching and taking out of coke; and one extra man is sufficient for attending to 10 fires. But the great advantage of the slopers lies in the fact that neither skilled nor heavy manual labor is any longer required in the retort house. The old stokers, who enjoyed all sorts of privileges, and often felt themselves the real masters both of the works

and of the situation, have disappeared, and with them a great deal of the engineer's trouble and anxiety. The few men left, knowing that they can be replaced without difficulty, do their best to give satisfac tion to their employers, and thereby retain their well paid and easy work. It is, therefore, not to be wondered at that the popularity of slopers and the increased demand for them on the Continent—especially in Germany—is growing apace.

## The Carbonizing Plant of a Modern Gas Works.

[A paper prepared by Mr. F. D. Marshall, of Copenhagen, Denmark, for the 8th Meeting of the English Institute of Gas Engineers.]

In 1896 the writer had the privilege of reading at the annual meeting of this Institution a paper on the "Monier System of Cement Construction as Applied to Gas Works," with a partial description of the coal stores at the Frederiksberg works of the Danish Gas Company. Last year, facilities were afforded for describing the method of discharging coal by the Hunt's system, storing in the large bins or pockets, and the eventual transport by rail and re storage in the bins or pockets at the gas works previously alluded to. It is now proposed to bring the carbonizing plant at the same works to your notice; and, if permitted, the writer hopes at some future time to complete the series, by describing the coke handling methods employed.

*Coal Storage Plant.*—For the sake of clearness and sequence, it may perhaps be permitted to shortly recapitulate the course of the coal, from the moment of arriving by steamer, until placed ready for use in the retort house.

The coal is lifted, as described in last year's paper, by the 2-ton Hunt's grabs, and stored in the Monier bins or "pockets" at the harbor. This machinery, it may be remarked, has now been in use for some time; and it is even more successful than was anticipated—the cost of unloading and storing being lower than previously quoted.

Anyone interested in the matter is invited to inspect this unique and labor saving installation, which will well repay a visit, even at such a distance as Copenhagen.

From the large stores at the harbor, the coal is conveyed daily by train to the smaller stores on the works, which contain a week's supply, or about 1,000 tons. The coal trucks, each containing 10 tons, are specially constructed with flap doors in the bottom. They are run over a pit, and the contents dumped into the same. The coals, after passing the crusher, are elevated at the rate of 1 ton per minute, and deposited by means of the overhead conveyor in the funnel-shaped "pockets" or bins of the store, which were minutely described in the paper of 1896. From the bins, the coal is transferred by the lower conveyor band to the three elevators supplying the hoppers in the retort house.

At the time of reading the paper describing this machinery, the writer was not in a position to quote exactly the cost of handling and storing the coal by this method. Since then, however, the exact figures have been ascertained, and as they may prove interesting they are given below. By the aid of two men, 120 tons of coal are handled—that is to say, they are received, crushed and stored at the rate of 1 ton per minute, and simultaneously removed from the store and conveyed to the retort house at a like rate. The train conveying the coal to the works consists generally of from 10 to 14 wagons, containing from 100 to 140 tons; and this quantity, allowing time for shifting trucks, is disposed of in about 3 to 3½ hours. The installation is successful to a degree; and it has not failed for a single hour since started three years ago. The wear and tear is inappreciable, and the question of labor (sorrowful as it is to say so) is reduced to a vanishing point.

Referring to the matter of prime cost, the question will be asked, Can such an installation pay? Here are the figures based on the fact of the installation having cost complete £3,500, and destined to handle 30,000 tons of coal annually:

| | |
|---|---|
| One man, storing, 3 hours daily, supplying hoppers in retort house and clearing up, looking to engine, etc., 3 hours daily, at 3½d. per hour, say annually..... | £33 |
| Two men shifting trucks, 3 hours each at 3½d..... | 33 |
| Oil waste, brooms, annually..... | 30 |
| Depreciation on £3,500 at 2 per cent..... | 70 |
| Interest on £3,500 at 4 per cent ..... | 140 |
| | £306 |

On an annual quantity of 30,000 tons this equals 2.44d. per ton, for unloading, storing, supplying retort house, and including wear and tear and interest on capital.

*Carbonizing Plant.*—The immediate object of this paper is to describe the carbonizing plant of the works in question, which are equipped with a complete and perfect installation of inclined retorts. The writer is, perhaps, one of the pioneers in the adoption of the inclined system of retort setting, for after a visit to M. Coze at Rheims in 1889, he was permitted by his Directors to erect an experimental 9-retort oven, heated by a Hasse-Didier furnace, at the old Frederiksberg works of the Company. This oven was gradually perfected; and eventually, five years ago, the retort house at the Odense works was fitted with an installation of 51 retorts. This installation, proving in the highest degree satisfactory, was used as the model for the retort house as the new works.

The plant consists of three benches, each containing 51 retorts (five settings of 9 and one of 6 in each bench), or a total number of 153 retorts. The angle is 32°, and the dimensions of the retorts are 21 inches by 18 inches by 11 feet 6 inches long, through the longitudinal axis. They are heated by tubular generators of special design; and such is their efficiency that last year's fuel consumption was 9.5 pounds of coke used per 100 pounds of coal carbonized, and the heat escaping to the main flue is barely sufficient to maintain the necessary draught. At any rate, the main flue is quite black; and the analysis of the escaping gases gives on the average 18 per cent. of carbonic acid, and about 0.20 per cent. of carbonic oxide.

The retorts are set entirely with block stones, very few or no bricks being employed, excepting to line the furnaces. The presence of many joints, however carefully made, is a source of weakness, causing settlements, with the result that the retorts lose their alignment. This is obviated to a great extent by using the block stones instead of brickwork. Coupled to this, a less clever man can complete the setting; for, given a good drawing, and the block stones numbered, he sets to work as happily as a child with a box of toy bricks. There are no baffle walls, no intricate passages, and no nostrils to choke up—all being open, and easy of observation and access in every part. The result is a beautiful and uniform heat.

The sides of the retorts are parallel, excepting at the upper ends, where at the mouthpiece, for a length of about 2 feet, they are constricted in a peculiar manner; the first 2 feet having a distinctly greater angle than the body of the retort. This was found by experience to greatly assist the even distribution of the coal; and, what was of still greater moment, it induced the last portion of the coal, or that with the least speed, to adjust itself properly in the mouthpiece of the retort, and not remain on the iron.

The generator is immediately under the setting. This is a controversial question; but having in view that the ultimate mission of a generator is to save fuel, and not to be an obstruction in the cellar, or a hindrance to coke handling machinery, the writer is inclined to think that its proper place is under the setting.

The retorts are charged from three fixed hoppers, one to each bench, fed by the three elevators from the coal bins or pockets. These elevators are supplied by the lower conveyor band previously referred to. Each hopper contains 61 tons of coal, or 12 hours' supply for each battery. They are filled by the man in charge of the coal store at 6 A. M. and 6 P. M.

The retorts are charged by scoops running on a light railway, three scoops to each bench (one for each tier). As the railway is continuous, the supply can be obtained from any hopper in the event of the hopper attached to any particular battery being out of repair. There is a total absence of conveyors or other machinery in the retort house, and consequently no clatter or noise; all being of the simplest description.

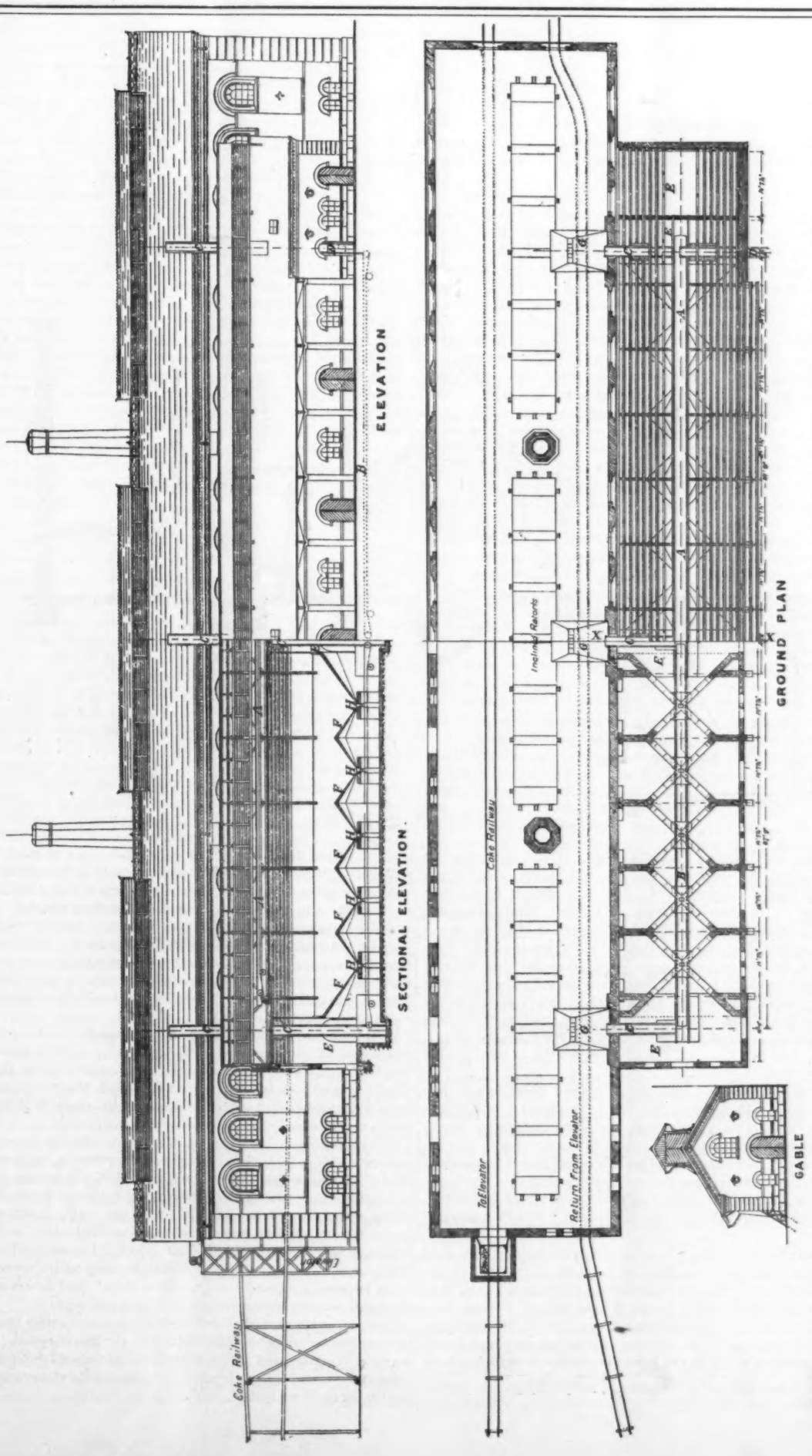
The upper and middle floors are constructed of the lightest steel beams and plates, all of the most gossamer-like description—this with the idea of saving structural expenses. The house is well ventilated. The upper or charging doors are jacketed with asbestos; and there is no oppressive heat to worry the men employed.

The greatest possible attention has been paid to the hydraulic mains and over bench fittings; all caps and openings being fitted with manhole faced doors and screws. Each hydraulic is fitted with leveling screws, and there are no loose bolts or luted joints whatever. As the writer's old friend, Mr. John West, remarked when inspecting the arrangement, "This isn't competition contract work."

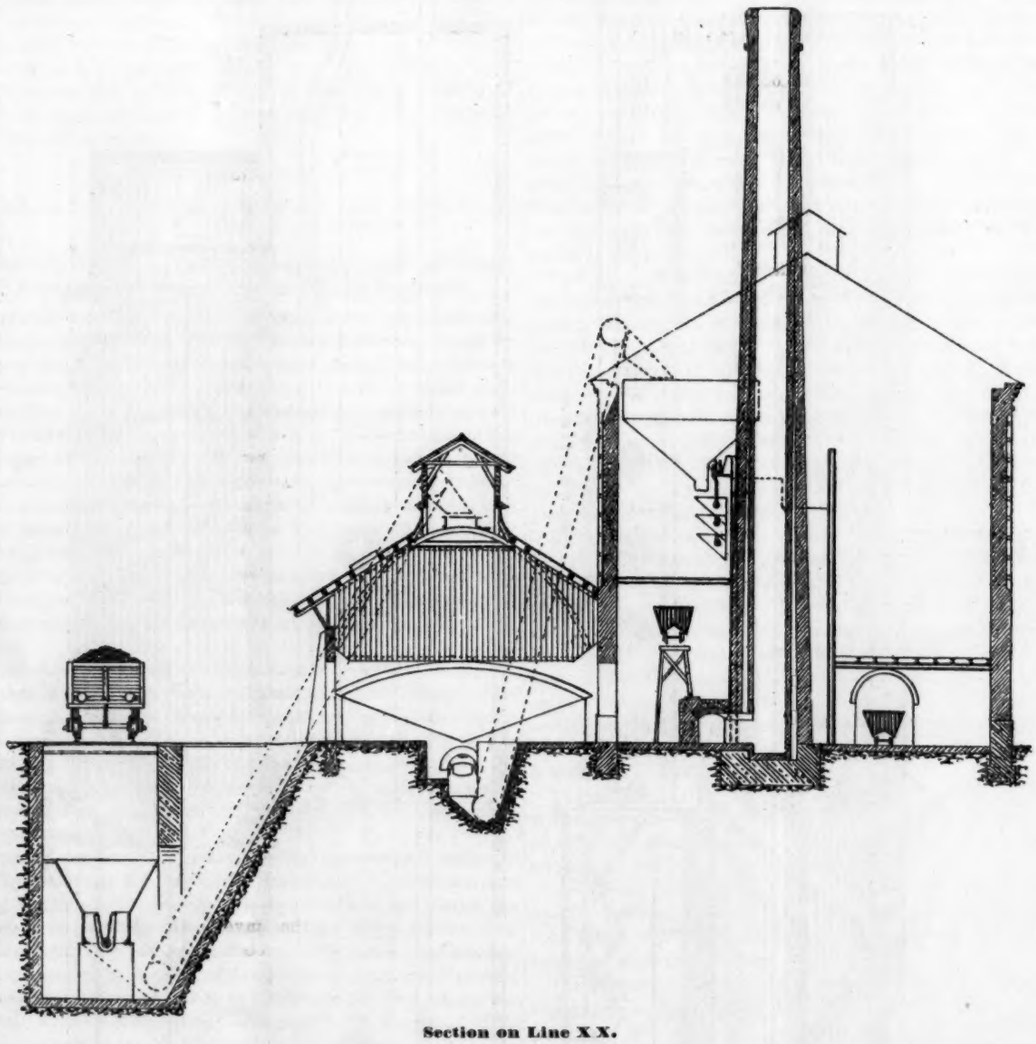
A stopped pipe—that man-killing nuisance—is almost unknown, and the professional pipe jumper is not on our staff.

The entire installation of the benches, including all iron, brickwork and labor, was carried out by the Stettiner Chamotte (Didier) Company, and the writer has pleasure in testifying to the thoroughness exhibited throughout.

*Working Results.*—Stokers' wages, 8-hour shifts, 4s. 6d. per shift.




**Coal Store Fitted with West Marshall Automatic Filling and Emptying Machinery.**—*A*, filling conveyer; *B*, emptying conveyer; *C*, elevator from emptying conveyer to coal hopper; *D*, elevator from tipping hopper to coal store room; *E*, engine room; *F*, Monier arches; *G*, coal hopper; *H*, emptying regulators.



Section on Line X X.

One man charges and draws 24 retorts per shift. One man carbonizes 10,320 lbs. coal per shift. One man produces (at 10,800 cubic feet per ton) 49,680 cubic feet of gas per shift.[1] One man attends to six fires per shift, clinkering the same once every 24 hours. The carbonizing wages per ton, including one man cleaning lids and tidying the retort house, clinkering and cleaning fires, looking to the water supply of the furnaces, etc., 1s. 6d. per ton—this price being from the time the coal leaves the hoppers until the moment the coke is quenched in the cellar. Each retort carbonizes per diem 1,720 lbs. Each retort produces per diem 8,316 cubic feet of gas. The life of a retort is 1,000 working days on the average, and produces during its life 8,316,000 cubic feet of gas. Each bench requires for fuel, on the average, 9.5 lbs. of coke per 100 lbs of coal carbonized.

It will be remarked, no doubt, that the retorts are short, being only 11 feet 6 inches long. Respecting the length of inclined retorts, the writer, together with other Continental engineers, holds very strong views. It is believed that where failures have occurred with the inclined system (and it cannot be denied that failures have happened), it can be traced to the excessive lengths of retorts employed.

To this fact, too, may be traced the falling off in illuminating power, of which so much is heard in England, and which "Field's Analysis" proves.

One of the drawbacks to the inclined system, and, in fact, the most serious one, is the quick accumulation of graphite or "scurf" in the upper ends of the retorts. This accumulation is very marked even in 11 foot 6 inch lengths, and in highly heated 20 foot retorts it must be a much more serious matter. With short retorts, there is absolutely no falling off in illuminating value, although worked at very high heats. To remove the pressure at the top of long retorts, the remedy has been tried of taking the gas off at the upper ends; but, as might have been anticipated, "the remedy has proved worse than the disease."

Another point in favor of the short retorts is that they can be set in one length, the weakness of joints being thus avoided. Setting inclined retorts even in short lengths is a very delicate matter, for the whole setting has an inclination to slide forward. With heavy 20-foot retorts this is very appreciable, and ponderous backstaves and retaining anchors are often employed to keep the retorts in their places. With short lengths, this tendency to slide is reduced to a minimum, and anchors or backstaves are not required.

Again the cost of the setting and the house for the long retorts is enhanced out of proportion to the labor saved, the gas produced, and the duration of the setting, as compared with the settings of short lengths. This is a controversial matter, but although the writer might, under certain conditions, be tempted to increase the length to 15 feet, no arguments would ever induce him to exceed that length.

Comparing the inclined system with power stoking, the writer argues that everything, including common sense, points in favor of the former plan. Elevators and hoppers are needed in either case, but here the similarity ends. For the inclined system the retort house may be more cheaply and lightly constructed; and the costly installation of the power stoker, with its power raiser, its skilled labor, and its endless wear and tear, are entirely dispensed with. Power stoking is a costly Colossus, turning an otherwise decent looking retort house into something between a pithead and a machine shop. No! power stoking is an elephantine achievement for the picking up of pins.

Comparing the cost of carbonizing per ton, the writer has no definite information as to the results obtained by the power stoker; but he can scarcely imagine that when everything connected with stoking machinery is taken into consideration, it can work out as cheaply as stoking on the inclined system.

1. If the furnace cleaner is taken into consideration, the quantity per man per shift equals 33,000 cubic feet.

Regarding the cost of installation per mouthpiece, the inclined system is at present handicapped by monopolies and harassing royalties; but once these hindrances are disposed of, there is no question in the writer's mind that the inclined plan will work out considerably cheaper.

Inclined settings are undoubtedly much more expensive to build than horizontals—perhaps 50 per cent.; but against this must be set off the extremely costly power stoking machinery. The installation at the Frederiksberg works, including hoppers, elevators, all iron and brickwork, worked out at £103 per retort; and the writer would be glad to know how this compares with first-class stoking machinery.

Personally the writer has nothing but praise for the inclined system, and that it is appreciated by the men is evident from the fact that he has been personally thanked by the Socialist leader of the men's Federation for having lightened their labor. This is very gratifying, and if nothing else has been gained by adopting the plan but a Socialist's thanks, then indeed we hold a proud and enviable position.

Mr. Marshall added that they had found dusty coal had a tendency to creep down generally on being heated. If one heated manganese in a closed retort, gas bubbles were formed, and created a little sort of volcano; and he believed something of the same kind happened in inclined retorts. With very fine coal, the upper surface became carbonized quickly from the heat, the gases underneath were compressed to a certain extent, and eventually produced a little volcano in the coal, which caused it to be disturbed, and there was a movement towards the mouthpiece. He did not know of any other reason to account for it; but it was perfectly true that coal did slip down to a certain extent, especially when it was very dusty.

## Municipal Franchise Contracts.

[A paper read by Mr. H. E. Keeler, at the last meeting of the American Water Works Association.]

Private enterprise and capital, when guided by a thorough knowledge of the situation and requirements and the results desired, have enabled many cities and villages of our country to secure a satisfactory water supply which was an absolute necessity to public comfort, health and safety, and which they would have been utterly unable to obtain otherwise. Prominent among the obstructions in the way of public works stand constitutional limitations upon borrowing money or incurring indebtedness by municipalities. Many communities are unwilling to go into debt to the extent necessary to construct a proper system of water works and keep the mains extended to meet the demands of rapid growth. Sometimes the necessity for sewers, public buildings, schools, improved streets, fire departments or other public requirements is so pressing that the amount of money which can be raised by taxation or borrowing is devoted to some of these purposes, while private capital is available to procure a water supply. Besides this, the success of many American cities in dealing with those affairs which must be left to municipal control has not been so conspicuous as to encourage thoughtful and conservative men to extend their functions. It may well be doubted whether the true plan should not be to carry on by private enterprise, under proper control, everything not governmental in its nature which is capable of being so conducted. The well-known higher cost of all work done under municipal management, and the corruption too often connected with municipal affairs, afford powerful arguments in favor of private water works.

Whenever it is found desirable to construct a water system by private capital it becomes a problem how best to safeguard the interests of all parties concerned. The interests to be protected are those of the municipality itself and of its inhabitants, who are or may become consumers of water, and those of the bondholders and stockholders of the company. These interests, however, resolve themselves into two only. The public interests are all in the hands of the representatives of the people who have been elected to protect them, and whose action is binding upon all the individuals composing the public. The officers of the company, while acting within the scope of their authority, represent all the interests of the company, and their actions bind the bondholders as well as the stockholders. Unless both parties desire to deal honestly and fairly with each other, it is better to abandon the enterprise at the start.

A contract of this character must of necessity be for a long period of years, and through this entire period the conduct of both parties should be guided and controlled by the desire to carry out the contract and agreement as made in letter and in spirit. All the terms and conditions of the contract should be carefully thought out in the light of experience and the local conditions. There should be a strong determination on both sides to have everything thoroughly understood and clearly expressed. Then the conditions of the contract should be faithfully observed by both parties as expressed. Many cities are now endeavoring to annoy and harass the water companies, and to depress and destroy the value of their plants for the sole purpose of securing them at a valuation less than their real worth, entirely forgetting the great service rendered by the company in the early days of its existence, when it came to the aid of the community and helped to develop and build it up.

In nearly all cases the earnings at the beginning do not more than pay operating and fixed charges, and frequently they are not even sufficient to do that. The company bases its expectations of profit on the future growth of its business, and this is the work of years. Often the struggle for a bare existence ends in the appointment of a receiver. Of course, those who put their money into water plants do it for profit, and they expect an average profit which will fairly compensate them in view of the delay in returns and the risk they run. Moreover, the ability and skill required to make the enterprise a success are entitled to fair compensation. Thus, on all accounts, they are fairly entitled to considerably more than the bare interest on the money invested. The highly profitable private water plants are exceedingly few when compared with the large number in existence. I repeat, the percentage of those is small which are successful from the time they went into operation to date. A large number run for years without profit, and some until their final collapse. Indeed, this is so evident that we may reasonably assume the municipalities also expect that the water companies will realize fair profits on the construction and operation of their plants.

Nearly all franchises granted within the last 20 years provide for an option by the city to purchase the plant at some fixed period at a valuation to be determined in the manner provided for in the contract. Within the last few years, where these options are about to mature, in quite a number of cases there seems to have developed a strong desire on the part of the public authorities or of individuals to take every advantage and to overreach the water companies in every possible way to diminish the value of their property and practically confiscate them outright. This is done by all sorts of attacks, such as excessive taxation, interference in the operation of the works, or other adverse legislation in some of the numerous ways devised to accomplish the desired end. It seems strange that anyone who pretends to possess a sense of justice should stoop to such conduct, but the sad fact remains.

In formulating a water works franchise or contract it should be considered that the municipality furnishes the use of the streets and other public rights of way for the distributing mains and lines, and it also contracts for a supply of water for its use as a corporation, and for its inhabitants for their private use. The agreed compensation for such use constitutes the entire income of the company. The city agrees to pay for the service of fire protection, sewers, parks and public buildings. The contract also fixes the rates to be paid by the inhabitants for domestic, sanitary or manufacturing uses. The municipal authorities, through the power delegated to them by the legislature, and as the elected representatives of the people at the time of making the contract, determine and name the rates that shall be paid and received for the various kinds of service. This course has been followed for years as right and just to all parties, and has been constantly sustained by the courts. Latterly several attempts have been made to change arbitrarily the rates expressed in the written franchise or contract, but so far without material success.

A private water company was operating in a suburb of Chicago, which was annexed to that city in 1893. This company has a legally granted franchise and contract which specifically fixed the rates for water for municipal and private use. In October, 1897, the City Council passed a brief ordinance which provided that this water company should charge the same rates for water supplied by it to private consumers which were charged by the City of Chicago for water supplied by its works. This ordinance pretended to impair the contract made by the original ordinance, which prescribed the rates authorized to be charged for water supplied by the company. It was obviously unfair and unjust, because it attempted a change in the terms of the contract by one of the parties thereto without the consent of the other. Furthermore, the cost of the service to the company was very much higher than to the city, because the city pumps about twice as much water in a day as the company does in a year, and the quality of the city service and water is notoriously bad and that of the company admittedly good.

Argument is not necessary to show that it is not reasonable to ask the company to furnish perfectly clear, filtered water at a high pressure at the same rates as the city charges for unfiltered water at a low pressure.

The company was not consulted, and no effort was made by the City Council to ascertain the merits of the case. A suit was brought to test the validity of this ordinance, which is now pending in the Supreme Court of Illinois. Meantime, the ordinance has been disregarded by the company and it continues to charge at its former rates. Somewhat similar attacks have been made in Carlisle, Freeport and Danville, Ills.; in Denver, Col., as well as in other cities, which have resulted in litigation, but in no instance has any municipality finally succeeded in its attempt. As the result of numerous instances of municipal bad faith in such matters a general distrust prevails in financial circles and these franchises now go begging, to the serious detriment of many communities which are thus deprived of water works.

The proper way to draw up a franchise contract would be to grant to the company the right to erect, operate and maintain the water system free from municipal competition, which should at all times furnish a clear, wholesome, potable supply of water, ample in quantity and under a minimum and maximum pressure, and so constructed as to make ample allowance for future growth. Provision ought to be made so that future extensions can be demanded and compelled to supply actual future needs and growth, but not speculative real estate deals. The capacity of the plant should be clearly and definitely expressed, with provision for maintenance and capacity intact during the entire life of the contract.

The rates for all service, either public or private, should be such as will insure a fair return on the capital actually invested, but not on fictitious bonds or stock. The water rates should be on a sliding scale; higher for the first few years and descending as the business increases. In fixing the rates local conditions are of supreme importance, for no two plants are operated under the same conditions. The city should reserve to itself the right to purchase the system and to become its sole owner.

To arrive at a fair basis for such purchase requires the consideration of all the circumstances and conditions which go to make up the situation as it actually exists, and not all of these can be predicted with accuracy at the time the contract is made. The object for which water works are constructed is to obtain the best possible water supply at the lowest rates for the service consistent with good business management, which must always contemplate depreciation and enlargement and reasonable return on capital invested. To attain this object municipal water systems are perpetual in duration; are monopolies; pay no taxes, and have the free use of streets and public grounds. In order to obtain the same object, the same rights ought to be granted to private systems. These systems, though built by private capital, are quasi-public in their functions. Water works are a natural monopoly, and ought to be recognized and protected as such.

This proposition secures ready assent when applied to the municipal works, and the logic is unanswerable in all cases where operation depends on special privileges or franchises. One company is better than ten for the public convenience, whether the object is to operate a gas, telephone, street railway or water company. Competition never permanently reduced the rates in any of these cases; but the duplication of systems surely increases the cost of construction and operation and gives no better service. In most cases the public has to pay this increased cost sooner or later. If not, it becomes a causeless waste and ought to be avoided. Every imaginable benefit to the public can be better secured by one system which is properly protected, limited and controlled. The failure to observe this principle has resulted in great loss to all concerned, while its recognition would result in decreased interest charges on capital and subsequent reduced rates for service, and would again enable communities unable to build water works for themselves to secure the assistance of private enterprise, which at the present time is next to impossible to do. Capital does not require high rates of interest, but it does demand honest treatment and certainty in its returns.

The rights and interests of the public and municipality are protected by the control which they reserve and their right of purchase. The municipality may properly be given the right to purchase the plant at any time on, say, six months' notice, provided the proper elements are considered and a proper method is fixed by which to ascertain the purchase price and mode of payment. The elements which must be considered certainly include the following:

First, the cost of the plant, including a fair construction profit. This should cover adequate compensation for skill and time thus employed. Second, interest on the cost. Third, compensation for risk and development of the business.

Once more, local conditions are of controlling importance, and no two systems will stand on the same basis. The cost of construction of the plant and all betterments should be ascertained at the time of construction; facilities for complete investigation should be extended; all books and vouchers be open to the municipality, and all accounts verified. To this should be added, say, 20 per cent. for a construction profit, and this fixes the price at which the municipality is then entitled to purchase. The outstanding bonds, if any, must be assumed by the city and the balance paid in cash, unless otherwise agreed. If the purchase is delayed, then interest on the price thus fixed is to be computed, and also the agreed rate to cover the risk, and a fair valuation for the developed business, which is the result of years of skillful and experienced operation. It will be readily conceded that if the plant is in successful, profitable operation, so that the possession of it is desirable to the city, the company which made it so should be entitled to just compensation for having attained such a result. The amount of such remuneration is easily arrived at and ought to be readily conceded and added. From this amount should be deducted the net earnings of the company for the period, including whatever accounts may have been carried to the depreciation or sinking fund account. The result thus ascertained would be the purchase price.

All water should be supplied through meters except that for use of the fire department for extinguishing fires, and sewer department for flushing purposes. Then low rates per 1,000 gallons could be fairly and safely made so that free, liberal, legitimate use may be had of the necessary service at a minimum cost. It is a well known fact that more water is wasted than is legitimately used, and in all schedules of assessed or frontage rates this item of waste has to be considered, and thus the careful, proper user of water is compelled to pay for a waste he does not cause, and for which he should not be obliged to suffer. Experience and records show that selling water by measurement is as proper and equitable to all concerned as in the case of any other commodity, and the great increase in the use of meters shows that this fact is being rapidly recognized.

The local conditions, which vary so radically in the different communities, make it impossible to submit what might be considered a model form of contract, but the principles endeavored to be laid down in this article may be safely used to produce a contract just to both parties which ought not to lead to friction in the future.

In conclusion, it seems to the writer that there is not only a necessity for the existence of private water supply, but that a fair, safe and just contract can be made by which both the municipality, unable to build for itself for various reasons, and private capital engaged in that capacity, can mutually undertake the enterprise with satisfactory results to both. Municipal franchise contracts granted and made for water supply should obtain for the water company the same security and protection in their rights and property as are enjoyed by other investments. Public control of rates charged for water service based on cost plus a reasonable profit, eliminating municipal competition, is a proper safeguard for the interests of consumers, investors and taxpayers.

## Inaccuracies in the Determination of Carbon and Hydrogen of Combustion.[1]

By Mr. Charles F. Mabery.

I was much interested in the results of Mr. G. Auchy which appeared in the April number of this Journal, since they are closely in line with my own observations in determining these elements in hydrocarbons, and an examination of this subject which I have now in hand. During the last five years in my work on the composition of the petroleum hydrocarbons, these determinations have occasioned much trouble and expense on account of the difficulty in keeping the details under control. The difficulties which I have encountered are the following:

1. An efficient and durable means for removing carbon dioxide and water from air and oxygen.

2. Maintaining a sufficient temperature to prevent gaseous hydrocarbons from escaping without complete combustion.

3. Incomplete absorption of carbon dioxide in a 33⅓ per cent. solution of potassium hydroxide.

4. Escape of moisture from the potassium hydroxide bulb, over fused calcium chloride and potassium hydroxide.

I now have these details under such control that assistants and students, by following directions, may be sure of obtaining correct results.

It is not the purpose of this note to discuss these details in full, since, as mentioned above, I have work in progress for the purpose of ascer-

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taining the limits of these sources of error, including the forms of potash bulbs.

That it is not safe to trust to the calcium chloride attachment of the potash bulb, even when it contains solid caustic potash, as ours always does, to retain all moisture, is shown by the following results, in which a second sulphuric acid tube was placed after the potash bulb. These results are taken at random from notes on combustions recently made:

0.1402 gram of a California distillate, 138°–140°, gave 0.4485 gram carbon dioxide, and 0.1897 gram water.

| | |
|---|---|
| Carbon | 85.00 per cent. |
| Hydrogen | 14.60 " |

Gain in second sulphuric acid tube 0.0007 gram.

0.1413 gram of a California distillate gave 0.4372 gram carbon dioxide and 0.1851 gram water.

| | |
|---|---|
| Carbon | 84.84 per cent. |
| Hydrogen | 14.56 " |

Gain in second sulphuric acid tube 0.0022 gram.

1.1420 grams of a hydrocarbon from commercial paraffine, boiling point, 306°–308°, fifty mm., gave 0.4434 gram carbon dioxide and 0.1882 gram water.

| | |
|---|---|
| Carbon | 85.19 per cent. |
| Hydrogen | 14.73 " |

Gain in second sulphuric acid tube, 0.0012 gram.

0.1384 gram of a paraffine distillate, 294°–296°, fifty mm., gave 0.4293 gram carbon dioxide and 0.1842 gram water.

| | |
|---|---|
| Carbon | 85.07 per cent. |
| Hydrogen | 14.82 " |

Gain in second sulphuric acid tube, 0.0015 gram.

0.1443 gram of a paraffine distillate, 338°–343°, fifty mm., gave 0.4507 gram carbon dioxide and 0.1884 gram water.

| | |
|---|---|
| Carbon | 85.45 per cent. |
| Hydrogen | 14.51 " |

Gain in second sulphuric acid tube, 0.0015 gram.

0.1423 gram of a paraffine distillate, 258°–260°, fifty mm., gave 0.4441 gram carbon dioxide and 0.1423 gram water.

| | |
|---|---|
| Carbon | 85.09 per cent. |
| Hydrogen | 15.08 " |

Gain in sulphuric acid tube 0.0016 gram.

0.1368 gram of a California distillate, boiling point 139°–140°, gave 0.4309 gram carbon dioxide and 0.1837 gram water.

| | |
|---|---|
| Carbon | 84.96 per cent. |
| Hydrogen | 14.72 " |

Gain in second sulphuric acid tube 0.0009 gram.

0.1459 gram of a California distillate, boiling point 188°–189°, gave 0.4559 gram carbon dioxide and 0.1886 gram water.

| | |
|---|---|
| Carbon | 85.70 per cent. |
| Hydrogen | 14.40 " |

Gain in second sulphuric acid tube, 0.0016 gram.

Unless great care be exercised in the rapidity of the combustion I suspect loss of carbon dioxide, but have not yet attempted to prove it. It will be seen that these results confirm the observations of Auchy, Drown, Blair, Dudley and others, that the ordinary form of potash bulb will not retain all the moisture unless the operation be controlled with the greatest care. Another serious difficulty with us has been the impurities in the granular copper oxide. In blank tests it does not cease to cause an increase in weight in both sulphuric acid tube and potash bulb until it has been heated in oxygen as long at least as it would be in six combustions. But when constant it apparently remains so.

## Aluminum as a Fuel.

At a meeting of the German Electrochemical Society, held in Leipsic last April, a very interesting discussion occurred on the possibilities of aluminum as a fuel. The gist of the discussion (as the same was translated by Dr. Goldschmidt for the *American Manufacturer*) is appended.

The use of aluminum as a refining and heat producing agent is based upon the high temperature developed by its combination with oxygen. As sources of the latter, oxides are most serviceable, but sulphides may also be used, although their heating effect is smaller. Instead of oxygen, sulphur can be used for the combination with aluminum, while aluminum may be replaced in some way by magnesium or calcium carbide.

The use of aluminum as a reducing agent is nothing new. This fact was pointed out by many scientists not long after the discovery of this metal, but they hardly ever operated with the oxygen combinations of the bodies to be reduced, using in most cases the chlorides or fluorides. The sulphides were ignored almost altogether. A number of chemical authorities have occupied themselves with the reducing power of aluminum, but all operated with very small quantities, heating the mixture in a glass or crucible within a muffle, or through the wall of the vessel. The reaction in those cases was often so violent that vessel and contents were lost, while only occasionally could small quantities of aluminum alloys be recovered.

Claude Vautin especially called attention to the fact that a large number of metal oxides could be reduced by aluminum. He, too, heated his mixture from the outside by placing the crucible with its contents in a coke fire. In the same way Greene and Wahl succeeded in producing pure manganese.

As the reaction between aluminum and oxygen combinations is very violent, it was of first importance to secure control and utilize the power thus developed, and to prevent the sudden and violent boiling which formerly rendered the whole work futile. In the first place, the important fact was realized that it was not all necessary to heat the mixture throughout to the temperature of ignition, but that it was entirely sufficient to create this heat at one single point. From there it was transmitted, more or less, throughout the whole mass, and from a heat consuming it became a heat producing process.

Starting out from tests for the production of chrome, it was seen that it would be very difficult to obtain the necessary temperature even at one single point, but this difficulty was overcome by using an easier ignitible mixture for the initial stage of the process so as to transmit this heat to the more refractory mass. Its components of such a charge superoxides are the best, but other combinations such as lead oxide, copper oxides, super-manganate of potash can be used to good advantage.

The process, it was shown, had the further advantage that pure metals free from aluminum could be produced, if the respective metal oxide be used to a slight excess. Thus, there were given two different uses for the process; first, the utilization of the heating power developed by the aluminum mixture, second, the utilization of its reducing power for the production of pure metals or alloys.

The working method has to be adapted according as one or the other of those two purposes is in view. When indifferent substances are added to the mass, the heat can be kept low enough to prevent the melting of the body to be heated and the separation of the metal reduced.

The product obtained is rather a sintered mass which forms a perfect casing around the body to be heated. When the mixture is to be used as a means for generating heat where the temperature should be kept below a certain point Goldschmidt adds to the mixture some inert matter. In such a case a large excess of cheap oxides, such as iron oxides, iron ores, sand, etc., is used with a limited quantity of aluminum. The whole mass once ignited will form a slag without much reduction taking place and will heat up any object placed in its center. The inert matter that in some such cases is added to the mass may be magnesia, lime, etc. If on the other hand metals are to be produced, no inert matter is added, so that the heat developed is sufficient to melt both metal and slag. For heating a rivet, for instance, it is firmly imbedded in the heating mixture consisting of pulverized aluminum, iron oxide, sand, etc.

Upon this casing is put a small ball formed of aluminum powder and any substance that delivers up oxygen readily. This ball is provided with a fuse of magnesium which is ignited. As soon as the casing is white hot all over, it is broken, and the rivet is found to be red hot and ready for use. There is, of course, much heat lost in this manner by radiation. In the practice it would be advisable to surround the heating mass by a non-conductor, such as sand or sod. This method can be used also for soldering and welding, it possessing the advantage over electric welding that a thoroughly uniform heating of the pieces can be obtained, while with electricity the greatest heat is developed at the places of contact and the adjoining parts remain comparatively cool.

As regards the production of metals in their pure state, chrome was first operated on. The temperature required has heretofore been produced by the electric arc only; it is estimated at 3,000° Centigrade. For this purpose a mixture of chrome oxide and powdered aluminum is placed into a crucible lined with magnesia, and the conversion started in the manner described above. Then more of the mixture is put in until the crucible is full. The converting process continues. By adding

the mixture more or less fast, or having it more or less dilute, the course of the process can be fully controlled, and practice will soon teach how it is conducted most advantageously.

This apparatus works much faster than the ordinary electric furnace, and at a very much higher temperature than is used, for instance, in the production of aluminum. Like the electric furnace, the apparatus can be arranged for continuous working by providing two tap holes, one for the metal, and the other for slag. It has the further resemblance to the electric furnace that in both the same difficulty had to be overcome. For a long time neither could be put to practical use, for as long as the heat had to be introduced from the outside, no crucible material was capable of withstanding the double action of heat and liquid bath. Not until the heat was produced in the interior was it possible to use the apparatus commercially and for production on a large scale.

In the production of 10 pounds of chrome, such an apparatus develops during the short duration of the process about 2,000 horse power. The outside of the crucible remains almost cold during the reaction, and not until the process is finished can the heat here be noticed. After 24 hours the whole is cool enough, that the crucible can be emptied, and the regulus be taken out. The slag immediately above the metal is aluminum oxide, which is best worked up again to metal. As the latter will still contain some chrome, it can be used for chrome production so that here a regular circle of utilization is given. The aluminum oxide can also be utilized directly, as it is perfectly free from hydrogen, and for this reason superior to the natural emery.

The metal yield obtained by this method of working is very high, and will approach in many cases 100 per cent., for the metal bath is covered at once by a layer of slag forming an airtight seal which prevents evaporation. Besides chrome, all other metals, for instance, manganese, iron titanium, borium, tungsten, molybdenum, nickel, cobalt, vanadium, tin, lead, cerium, and the other metals of the rare earths can be produced in the manner described, that is by endothermic reaction and free from aluminum. The recovery of barium, strontium and calcium is also made possible. The slag from this process offers another interesting feature. The slag produced in the recovery of chrome shows red transparent crystals within small hollow spaces. These crystals are undoubtedly rubies as the natural ruby also owes its color to chrome. But they are too small to possess any commercial value.

For the recovery of metals, of course, only pure aluminum should be used. It will then be easy to obtain pure metals free from carbon which has been a long cherished wish of metallurgists, especially in the case of chrome and manganese.

For heating purposes pure aluminum is not at all required. The crude product obtained directly from bauxite or other clay earth is fully sufficient, even if it contained less than 50 per cent. of aluminum. The silicon in it would be not only harmless, but it would rather promote the reaction. Such aluminum could surely be produced much cheaper than the present commercial article.

All the above shows that two new uses have been found for alumi num (to a smaller degree for magnesium and calcium carbide also). both being based upon its property as a heat accumulator by which it is made possible to recover and utilize the large amount of power expended in its production in the form of heat. Another step forward would be the recovery of electric power from the oxidizing process of the aluminum, and the utilization of a large part of the heat produced for power purposes. The great results expected from aluminum ever since its discovery will then be realized, even if it be in a different way from what was thought originally. It will then play the part of a power accumulator of the highest order rather than that of a metal.

## Lead Plumbing.

"M. A. C.," writing on this subject in the *Metal Worker*, says:

I think the plumbers will do well to advocate more generally the use of lead pipes for plumbing work. To please the eye it has been the cus tom to use in all the exposed piping, in bathrooms in particular, and other portions of the house, nickel plated brass pipes. These no doubt when kept in fine condition are pleasant to look upon, but the labor entailed in keeping them polished bright is no small item. This opinion is the result of experience. I had been doing nickel plated work for my customers for a considerable time, and my family had the same idea that many others had, that we must have nickel plated plumbing when we rearranged the bathroom in our own house—and I must confess that I took more or less pride that I was also to have a glittering bathroom. One of the first pipes to show the need of attention after my new bathroom was completed was the flush pipe to the water closet. I soon began to notice that the trap under the lavatory and the overflow and waste from the bathtub, as well as the service pipes to the different fixtures, were commencing to show the need of polishing, and for some time it has taken a good portion of a forenoon in every week to brighten these pipes up with polishing material.

I have no hesitation in saying that nothing would induce me to use anything but lead pipes when I plumb my house again. If a plumber is careful to keep the dents out of his service pipes and runs them true, in good alignment; wipes his joints of good form with fine solder, then soils his work neatly afterward, I think it presents an appearance that may not be as glitteringly attractive as the nickel pipes, but which cannot be said to be objectionable. If after the lead work is finished a coat of transparent varnish is given all the pipes, they will need no attention for years, and will retain a very satisfactory appearance. In case of repairs or accidents which require the piping to be taken down, it is far easier to take down lead work and put it up again than the nickel plated piping, which is often difficult to make tight again. If it is good for the shoemaker to stick to his last, I would say it is equally so for the plumber to stick to his lead.

## Alternating Current Transformers -from the Station Manager's Viewpoint.

[A paper read by Mr. W. F. White, at the Omaha Meeting of the Am. Inst. Electrical Engineers.]

In the early days of alternating central station development, many a sale of alternating central station equipment was lost to direct current competitors by the facts, figures and fancies which the salesman of direct current apparatus was able to advance concerning the wastefulness of energy, the expense of maintenance, and the danger to life which purchasers must accept as inseparably wedded to any transformer system.

Notwithstanding that the danger to life was unfortunately made much of, and the facts grossly misrepresented, still the correctness of many of those arguments, in the light of present knowledge, stand up remarkably well under the scrutiny of qualitative analysis. And it is even more remarkable, in view of the natural tendency to exaggerate induced by zeal to make sales, how little, if any, were the facts of these evils overdrawn or magnified. Quantitative analysis in fact proves that most figures then given to show the amount of transformer "leakages" were understated. On the part of salesmen this was undoubtedly more a mistake of the head than of the heart, for while some few of them knew the results of some isolated tests of some particular size of one type or manufacture of transformer, no one, whether salesman, engineer and designer, or manufacturer, had any knowledge or conception of the cumulative effect of transformer losses on the station output. Such little knowledge as had then been acquired related more to the transformer efficiency under certain percentages of rated load, than to all-day efficiency, or the 24-hour ratio of energy output to energy absorbed under average conditions.

Little, if anything, was known of transformer core losses, and the effect of power factor on station and line capacities had not had consideration. As long ago as 1892 the writer, in making a careful examination into the operations of one of the then largest alternating stations in this country, made the discovery that with a net meter rate to consumers of about 20 cents per 1,000 watt hours, the income per k.w. hour output at the switchboard was only about 6 cents, showing an average loss from station switchboard to consumers' meter of about 70 per cent.

Current was supplied, in accordance with the then existing universal practice, through one or more transformers for each customer. In two or three cases, for large installations, as many as 18 or 20 transformers were erected for a single customer, no transformer of more than 75 lights capacity being used; the transformer primaries connected in multiple, but the secondaries feeding entirely distinct and separate circuits.

Of each 1000-watt hours output at the switchboard it was estimated that approximately 300-watt hours were delivered through the customers' secondary meter, 600-watt hours were accounted for by transformer core losses, leaving 100-watt hours to be accounted for by transmission and other losses.

A statement of these conclusions to a well-known manufacturer, who supplied the wattmeters and many of the transformers, elicited the opinion that either the primary meters registered too fast or the secondary meters too slow.

A meter expert from the factory accordingly spent several weeks in

testing all primary and secondary meters, found them correct, and proved that the apparent discrepancy was not due to the meter end of the plant equipment. With the writer's recommendation that a 3 wire secondary network be erected, using 100-volt lamps, and fed through large transformers at frequent centers of distribution, the matter was dropped; but there is no doubt that the proportion of the output attributed to transformer losses was approximately correct.

Since that time it has been the writer's good fortune to be in touch with a considerable number of alternating plants, giving him knowledge of their operating results, and he does not hesitate to assert that very few plants exist, giving continuous service, using separate transformers for individual customers, and charging from 12 to 20 cents per 1,000 watt hours, secondary meter measurement, whose income per kw. hour output at the switchboard exceeds from 4 cents to 7 cents. In other words, the transmission, transforming and distribution losses are commonly as much as 200 per cent. of the customers' demand, as shown by the customers' meters. This does not mean operating expenses three times as great as if all these losses were eliminated, but it does mean that large expenditures are made for fuel and feed water for the keeping warm of numerous transformers operating about 20 hours per day with open secondaries. And great numbers of small transformers also mean great variations of secondary voltage, large bills for lamp renewals, unsatisfactory service and a reduced number of lamps which can be served at any instant from a given generator capacity. To show the benefits to be derived by using a secondary network, fed by large transformers working in multiple, but located one at each feeding point or local center of distribution, as compared with the use of small transformers, one or more to a customer, the writer presents some results accomplished by an existing plant in remodeling its transformer system in accordance with these ideas.

January 1st, 1895, this plant was serving 16,702 incandescent lamps (16-candle power equivalent) through 547 transformers of 22,190 lamps rated capacity, each transformer averaging 40.6 lamps capacity and serving 30.6 lamps. The transformer load, with open secondaries, was, as near as could be determined, about 80 amperes at 1,000 volts. In view of the fact that the maximum load never exceeded 50 per cent. of the lamp capacity connected, it was evident that a very considerable reduction could be made both in the number of transformers connected and in their aggregate capacity, by the use of a secondary network. The theoretical limit was to reduce the transformer capacity to equal the maximum load, which would lower the capacity connected from 22,190 lamps to about 7,000 lamps, a reduction of about 64 per cent. This limit was evidently impossible of attainment because of the large number of isolated installations, especially in the residence districts, requiring individual transformers, which of necessity must generally be of capacity equal to several times the average load. A system of 3-wire secondary networks was laid out, and estimates made showing a possible reduction of almost 80 per cent. in the number, and of about 50 per cent. in the lamp capacity, of transformers connected. A large number of tests of core losses of all sizes of transformers in service was then made, for estimating the total core losses for the plant, and for comparisons with the estimated core losses of the large transformers to be erected in replacing the old.

An illustration of one or two of these comparisons may be of interest. One installation of approximately 700 lamps was fed through a large bank of small transformers having an aggregate core loss of 4,440 watts, which could be replaced by two transformers having a combined estimated core loss of 310 watts. On the basis of the number of watt hours per pound of coal then being produced by the plant, not taking into account any line losses, this example shows the following results:

| | | |
|---|---|---|
| 4,440 watts, | 38,894,400 watt hours per year—requires | 190.6 tons coal. |
| 310 " | 2,715,600 " " " | 8.4 " |
| Annual saving, | 36,178,800 watt hours. | 182.2 tons coal. |

The annual income from this installation was about $2,100, at 12 cents per 1,000 watt hours. With a secondary output of about 17,800,000 watt hours, and transformer core loss of about 38,894,400 watt hours, the income per kw. hour output at the switchboard for this installation was evidently less than 4 cents, and the core losses were more than double the total secondary output.

In another case, one section of the city, comprising 10 city blocks, was fed by one dynamo and circuit through 71 transformers, having an aggregate rated capacity of 4,482 lights, and aggregate core losses of 10,402 watts (estimated), or 91,121,520 watt hours per year.

To replace these transformers, a 3-wire secondary network was erected, supplying all customers, and fed by five 400-light transformers, located at as many feeding points or local centers of distribution. Each transformer was provided with primary and secondary switches, by means of which each night all transformers were thrown into service from dusk until midnight, at which latter hour four transformers were cut absolutely out of circuit. On a yearly average, five transformers were in circuit about six hours per day, and one transformer the remaining 18 hours per day. The combined core losses of the five were about 1,250 watts, and for the hours in service aggregated about 4,380,000 watt hours per year. Some results of the above changes on this one circuit therefore were as follows:

| Number of Transformers. | Lights Capacity. | Total Core Losses—Watts. | Total Annual Core Losses—Watt Hours. | Equivalent Tons Coal. |
|---|---|---|---|---|
| 71 ..... | 4,482 | 10,402 | 91,121,520 | 446.7 |
| 5..... | 2,000 | 1,250 | 4,380,000 | 21.5 |
| Saving. | 2,482 | 9,152 | 86,741,520 | 425.2 |

A reduction of over 95 per cent. in core losses, and a saving for one year in cost of fuel alone of $815.40 were effected for this one circuit. These examples were extremes, because the lighting covered by them was concentrated; and because in most residence and outlying business districts few changes in the number and capacity of transformers could be made. The results shown by the last example were therefore much above the average for the whole plant, but serve to show the possibilities of such changes and the methods pursued in this case.

Some results for the plant as a whole may therefore be fairly indicative of what other average plants operating under similar conditions may accomplish in the same direction, and were as follows:

| Time. | Lamps Connected | Transformers Connected. | Total Capacity. | Average Lights Capacity. | Average Lights Served. |
|---|---|---|---|---|---|
| Jan. 1, 1895.. | 16,702 | 547 | 22,190 | 40.6 | 30.6 |
| Jan. 1, 1896.. | 19,282 | 201 | 13,865 | 69.0 | 90.1 |
| Jan. 1, 1897.. | 20,262 | 152 | 13,498 | 88.8 | 133 3 |
| Jan. 1, 1898.. | 23,643 | 141 | 14,946 | 106.0 | 167.7 |

| Year. | Income. | Switchboard Output, k.w. Hours. | Income per k.w. Hour Output. | Increase of Income per k.w. Hour Output. |
|---|---|---|---|---|
| 1894... | $59,012.71 | 928,400 | $0.0635 | |
| 1895... | 54,231.67 | 791,752 | 0.0684 | 7.7 per cent. |
| 1896... | 51,415.29 | 551,064 | 0.0933 | 46.9 per cent. |
| 1897... | 56,317.42 | 508,070 | 0.1108 | 74.5 per cent. |

| Year. | Actual k.w. Hours Output. | Estimated k.w. Hours Output—Basis 1894. Conditions. | Estimated kw. Hours Saved by Change. | Estimated Saving in Coal—1894 Basis. Tons. | Cost. |
|---|---|---|---|---|---|
| 1894 | 928,400 | .... | .... | .... | .... |
| 1895 | 791,752 | 854,042 | 63,290 | 310.2 | $670.91 |
| 1896 | 551,064 | 809,689 | 258,625 | 1,267.8 | 2,641.42 |
| 1897 | 508,070 | 886,888 | 378,818 | 1,856.9 | 4,015.43 |

It must be borne in mind that the number of 16-candle power equivalents connected Jan. 1, 1895, was 16,702, and increased by Jan. 1, 1898, to 23,643, or more than 41.5 per cent. The savings estimated in last table are based on the conditions at the beginning of this period—*i. e.*, the same number of transformers and the same transformer capacity. But if the same conditions had obtained throughout, an increase of 41.5 per cent., or 226 transformers, of 9,208 lights capacity, would have been added to supply the new lights connected. And while only a part of the core losses of the transformers in service Jan. 1, 1895, was saved by the change, the entire losses of the 227 transformers, which would have been required by increased business, were saved. It is therefore perfectly safe to add 50 per cent. to the savings shown in the last table, in estimating actual benefits. From reduced core losses alone, therefore, there is an annual saving of approximately $6,000.

In core losses alone, the savings already effected have more than paid all costs of the entire change of lamps, meters and transformers (for because of a simultaneous change from 52 volts to 106 volts, secondary, all lamps and meters also had to be changed), and of the erection of secondary network; and the annual saving of $6,000 is equal to 6 per cent. interest on $100,000, secured without one dollar invested.

To be certain that the saving of fuel was in proportion to the reduction in k.w. hours output, as estimated, the plant efficiency under the changed conditions must be known. It is therefore pleasing to note that, using coal from the same mine most of the time, the watt hours output per pound of coal actually increased for 1896 by 3.8 per cent., and for 1897 by 5.9 per cent. over 1895; so that the saving in fuel was at least not less than in proportion to the saving in k.w. hours output.

Some incidental advantages of the change may be mentioned.

*First.* Under the old plan, the 6,941 lights added would have required

about 9,200 lights additional transformer capacity, of 40 lights average size, of $1 per light average cost, giving an investment saving of $9,200.

*Second.* The transformer load, with open secondaries of 80 amperes, was reduced, by the fall of 1897, to about 30 amperes, notwithstanding an increase of about 25 per cent. in the number of lights connected. A saving of 50 amperes at 1,000 volts represents a capacity to serve, without additional station or line equipment, approximately 1,000 16-candle power equivalents, all burning at one time, or fully 2,000 16-candle power equivalents connected.

*Third.* Formerly as many as a dozen transformers were frequently burned out in a single thunderstorm. Ten per cent. of the transformers connected would be a conservative estimate of the number burned out each year from various causes. Of the new transformers connected during the past three years only one has failed from any cause, and that one was defective, and burned out under light load almost immediately upon being put in service. Transformer repair costs are therefore practically eliminated.

*Fourth.* Incandescent lamp renewals have been greatly reduced. Using lamps from the same factory, of the same efficiency, and bought at the same price per lamp, the cost (estimated) of renewals per k.w. how consumed by the lamps has been reduced from $.0081 in 1895 to $.0057 in 1897, a reduction of 29.6 per cent. This saving represents the advantage of regulating the secondary voltage by pressure wires connected to the second network, as compared with the former method of regulating the primary voltage by station transformers.

*Fifth.* The principal remaining incidental advantage is the uniformity of voltage, bringing uniformity in quality of service and the consequent satisfaction of customers, the value of which cannot be estimated in dollars or percentages. These are some actual results, and such as any plant operating under similar conditions can achieve at small expense, if the changes are well planned, and the replaced apparatus sold to the best advantage.

In this connection, attention must be called to one other fact, which is that central stations using separate transformers for individual customers have the great majority of their transformers working on open secondaries probably 80 per cent. of the time. The best transformers have a power factor of about 50 with open secondaries, and of fully 99.9 with almost any load they carry in practice. It is therefore perfectly credible, and the writer has demonstrated it to be so by many actual tests on various plants, that the average power factor of plants operating under above specified conditions is approximately 65.

It scarcely needs demonstration that if, instead, a secondary network is used, and only such transformers allowed to remain in circuit at periods of light load as are required to advantageously carry such load, the average power factor will be approximately 100. The volt ampere hours, therefore, calculated from the station voltmeter and ammeter readings, give approximately the watt hours output. But almost all existing plants use separate transformers for individual customers, and the great majority of them do not have primary wattmeters on their switchboards, and do calculate volt ampere hours output as equivalent to watt hours, getting results about 50 per cent. in excess of the facts. They therefore are able, apparently, to show 50 per cent. more watt hours per pound of coal, and 33⅓ per cent. less expense per k.w. hour output than another station operating under the same conditions and fully equaling theirs in actual performance, but which accepts the primary meter readings as the basis of estimate.

As a matter of fact, the usual disparity is greater than the percentages given, because most station managers in erecting primary switchboard meters, follow their aesthetic inclinations, and use ornamental glass covers which are practically susceptible to the admission of dust and grit, with the result that the meters rapidly slow down. It is highly probable therefore that in some stations the volt ampere hour record would show twice the number of apparent watt hours per pound of coal, and one half the expense per apparent k.w. hour output that would be shown by the record of the primary meter already erected on the switchboard, which tends only to show the worthlessness of data from different plants, for purposes of comparison, unless the local conditions are known in each case.

This digression is permissible, we hope, because the average power factor, so far as we know, has never been taken into account, and because for that reason much misleading alternating central station data is in circulation.

Purchasers and users of transformers should insist that transformers meet certain requirements, or be rejected, and some of these requirements will be stated.

Where transformers are used for feeding networks, the secondaries in multiple, small core losses are of much greater importance than close regulation, and should be kept at the lowest practicable point. The regulation will be cared for by treating the transformer and feeder drop together, through the use of secondary pressure wires.

Where the transformers are entirely independent, feeding separate secondaries, close regulation must be had and the core losses be made as low as the adopted regulation will permit. With constant full load the temperature must not rise to a high point, and should not exceed 50° Centigrade above the surrounding air. This is important not only because of the increased life of transformer insulation through low temperatures, but also, and possibly to a greater degree, because magnetic fatigue is a certain follower of high core temperatures. If therefore the core losses might be increased 50 per cent. or possibly 100 per cent. through high temperatures, the cost of these core losses, as shown in case of the plant above, make argument unnecessary as to the desirability of having transformers run cool.

The transformer case should be filled with oil, because of its insulating qualities, its exclusion of air, and because of its assistance in mainlaining the low temperature desired.

The insulation resistance between the primary and secondary windings should be able to stand up under not less than 10,000 volts, alternating, difference of potential, for transformers having 1,000 volt or 2,000 volt primaries, and the writer would strongly urge a 15,000-volt, alternating, test. If both the primary and secondary windings are on the core, the same insulation resistance should be required between either winding and the core, as between the two windings. The use of grounded shields placed between the primary and the secondary windings, the grounding of the shell or core, the grounding of the secondaries, the placing in each customer's service connections of any device to automatically open the circuit of such customer in case of an unusual difference of potential, are all practices that are opposed as expensive, as liable to cause, more than to prevent trouble, as complicating existing practice, and as wholly unnecessary.

Proper insulation is sufficient protection against the damages sought to be avoided. Station managers as earnestly desire complete safety for life and property as the Underwriters' Association, but vigorously oppose the introduction of any unnecessary devices that are expensive to install and to maintain. That Association, in seeking protection for the secondaries, should do so through sufficient transformer insulation and low temperatures. Both of these requirements mean increased cost of production and higher selling prices, but as the consequent increased economy makes the increased cost a profitable investment, no reasonable manager will object. In this way the ends sought will be best attained, and the interests of all parties duly safeguarded.

## The Shearing Resistance of Steel Rivets.

*Engineering Record* says it is a curious fact that, although the physical properties of structural steel as a whole have been well known for some years, there are quarters in which the shearing resistance of steel rivets is considered a property not yet quantitatively determined, or, at most, quite imperfectly so. This is curious not only because the experimental determination of the shearing resistance of rivets is a simple and inexpensive operation, but also because, as a matter of fact, that determination was made fairly completely in England at least 20 years ago, and in this country at least 15 years ago. It is not meant that at precisely these dates empirical quantities were established, but that they were comparatively well known, and that prior to or since these dates many authoritative determinations have been made.

An instance of this occasional doubt as to the shearing resistance of steel rivets is an interesting paper by Prof. A. N. Talbot, entitled "The Shearing Strength of Rivet Steel," in the *Technograph*. He states that "five years ago the use of steel for rivets in high grade boilers, standpipes and structures was considered doubtful practice by many engineers." Some engineers, perhaps, so considered it, but on the other hand, the best structural practice had for some years prior to that time not only recognized the merits of low steel rivets, but had adopted them in both the shop and the field. The capacity of such rivets to sustain the various kinds and degrees of torture incident to shop manipulation and manufacturing processes and their exceeding toughness and strength in the finished joint, had been well established by the crucial tests of experiment and experience in American practice certainly prior to ten years ago.

Furthermore, Prof. Talbot states that the ratio of the shearing to the tensile resistance of structural steel has been assumed to be 80 per cent., and the same general impression has been current in other quarters.

In connection with these observations Prof. Talbot cites the experiments of Prof. A. B. W. Kennedy, made thirteen or more years ago, and apparently assumes that they are the main basis of the empirical quantities employed in the design of riveted joints in this country. It would further appear it was in view of supplying data not hitherto available that Prof. Talbot undertook his interesting series of experiments on rivets. The steel of the rivets which he used was very soft, although the structural rivet steel was not quite so soft as the boiler rivet steel. Some of the latter contained as low as 0.011 per cent. of phosphorus and 0.031 per cent. of sulphur. The structural rivet steel contained 0.041 per cent. of phosphorus and 0.053 per cent. of sulphur. The tensile strength of the former varied from 47,000 to about 50,000 pounds per square inch, while the latter exhibited about 55,000 pounds per square inch.

He found that the ratio of shearing to tensile strength, other things being equal, increased from about 73 to 80 per cent. as the diameter of the rivet decreased from 1 to ¾ inch. This result seems to puzzle Prof. Talbot, for he remarks that "it would be interesting to know why the ratios for the small rivets are higher than those for the large." It has always been recognized that the thicker the area sheared, whether as a plate or a rivet, the less nearly simultaneous is the shear. In other words, the larger the diameter of the rivet, the more pronounced will be the shear in detail, and hence the less will be the shearing force exerted per square unit. Incidentally such secondary influences as the hardness of the plate, the width of the bearing surface, the sharpness of the edge of the hole and other similar conditions, will vary the results to some extent, but the greater degree of absence of a simultaneous shear, as with larger rivets, will inevitably decrease the rivet resistance materially, and that is the main explanation of the results observed by Prof. Talbot.

The ratio between shearing and tensile resistance which he thinks should be taken on an average at 0.75 instead of 0.8, has also been well established for nearly 20 years. In one of the standard American works on the resistance of materials, published in 1883, it is shown that Kennedy's and Kirkaldy's tests make the ratio from 0.7 to 0.8. The statement then follows: "For ordinary plates therefore in single and double riveting the shear as a mean equals 0.75 T. (tensile resistance)." In the same work will be found a digest of a large number of steel riveted joint tests made at the Watertown Arsenal, apparently not considered by Prof. Talbot, which confirm the conclusions already set forth. The Watertown tests have the further merit of being tests of actual riveted joints, thus involving all the conditions and influences which exist in a structure or boiler.

## Chemical Industry in Russia.

*Engineering* "notes" that official Russian statistics date the growth of chemical industries from the beginning of the eighties, when the Solvay ammonia soda process was introduced at Beresnjaki in the Government of Perm. Up to that time soda had been made by the Le Blanc process; but there was little demand for hydrochloric acid. At present the firm of Ljubimow and Solvay possesses three works, producing 4½ million poods of soda annually, including 1 million poods of caustic soda. The pood is about 36 pounds, there being 62 poods to the ton. The imports of soda have fallen from 2,011,000 poods in 1885 to 887,000 poods in 1894. A similar decrease in the imports is shown in most of the other branches, and is an unmistakable sign that the chemical industries of Russia are beginning to become independent. As regards the soda industry, however, there has been a special reason for so rapid a diminution in the imports. The purification of 1 million poods of naphtha products used to require 2 million poods of caustic soda annually. For a long time the soda residue was worthless waste, until improved processes were devised, and a regeneration of the residue in reverberatory furnaces succeeded. Baku now requires 300,000 poods for that purification, and half of this bulk is recovered. Glauber salt is found in vast quantities near Tiflis, but is little utilized as yet after Le Blanc's method. Most of the hydrochloric acid is transformed into zinc chloride for the impregnation of railway sleepers. The manufacture of chloride of lime after the Weldon process is increasing; the imports are still important, however, the figures for 1892 and 1894 being in poods 1,442,000 and 890,000. Potassium nitrate is manufactured by decomposing Chili saltpeter (nitrate of sodium) either with potash which comes from many districts of Russia in moderate quantities, or with Stassfurt salts. Both the raw materials have to be imported; the figures for 1893 were 290,000 poods of Stassfurt salts and 510,000 of niter. Of the six gunpowder works of Russia, three belong to the Government. The sulphuric acid industry is almost independent of foreign support. The five works of Baku used to start from sulphur obtained in Russia, Persia, or Italy. At present Russian copper pyrites form the chief raw material, which yields sulphuric acid and copper. A good deal of the sulphuric acid, used in the petroleum refineries, is recovered in a sufficiently pure state. Recently sulphur deposits have been discovered in Transcaucasia rich enough to allow of export. Hydrochloric and nitric acids are not important as yet, yet the imports have dwindled from 615,0000 poods in 1890 to 19,000 in 1894. Though Russia produced 103,000 poods of aniline and alizarine dyes in 1892, already worth over two million roubles, the raw materials could not be entirely obtained in the country. It is noteworthy that the Russian alizarine is prepared from anthraquinone, and not from anthracene, with the help of caustic soda, chlorate of potash, and sulphuric acid. The coal tar of coke ovens is collected, and benzine, anthracene, etc., are isolated from it. It is known that Russian chemists have succeeded in obtaining coloring matters from naphtha residue; the processes do not as yet appear to have found practical application however.

Chromates are made at the Ushkow works at Jelabuga, by fusing chrome iron ore, of which in 1893 nearly a million poods were thus used, with caustic soda. The Russian ultramarine can already rival any other. The dry distillation of wood was one of the chief small industries of the wooded districts of the north for the production of pitch, tar, creosote, turpentine, oil, vinegar, etc. This industry had shown a retrograde development, but it is expected that the new railways and the more enterprising spirit of recent years will help to revive it again.

Russian turpentine, though not of the first order, is exported in large quantities, whilst superior turpentine is still imported. The same applies to vaseline, which Russia sends to foreign markets in fair quality, obtaining her supply for pharmaceutical chemists abroad. The Russian glycerine is now so pure that the imports are not worth mentioning. Russian matches are not often seen in other countries; they are exported, however, and the country relies upon its own manufacture.

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Staunton (Va.) Gas Company have reduced the selling rate to $1.50 per 1,000 cubic feet.

MR. MONTAGUE TRIEST, Treasurer of the Charleston (S. C.) Gas Light Company, announces that the Board of Directors have declared a dividend of 62½ cents per share, payable since the 1st inst.

THE proprietors of the Dedham and Hyde Park (Mass.) Gas and Electric Light Company have put in force the following gross rate schedule:

| Quantity Used per Month. | Rate per 1,000. |
|---|---|
| First 5,000 cubic feet | $2.00 |
| Second " " or any part | 1.90 |
| Third " " " " | 1.80 |
| Fourth " " " " | 1.70 |
| Fifth " " " " | 1.60 |
| In excess of 25,000 cubic feet | 1.50 |

Prompt payment entitles the user to a discount of 10 per cent. The Company is rapidly increasing its business.

"MANAGER," writing to the JOURNAL under date of the 2d inst., says: "We are troubled with a leak in the upper cup of a 115-foot holder, and would like to know if any other manager or superintendent of gas works has had like trouble. If so, I would like to know how the location of the leak was determined, and how the leak was stopped, without removing the water from the tank. We have carefully examined the holder sheet forming part of the cup without detecting a leak. We think that it is in the outer sheet."

WE shall be pleased to print any replies that may be forwarded to the inquiry submitted above by "Manager."

THE Wilkes-Barre (Pa.) *Record*, of the 1st inst., had this to say: "The two gas companies recently consolidated consummated the deal yesterday. They combined their offices and will occupy the quarters of the old Wilkes-Barre Gas Company in the Welles building. The consolidated organization will be known as the Gas Company, of Luzerne, with the following officers: President, Abram Nesbitt; Vice-President, J. W. Hollenback; Secretary and Treasurer, E. W. Mulligan; General Manager, John Flanigan. These, together with the following, constitute the Board of Directors: Liddon Flick, J. A. Stearns, E. H. Jones, C. Stegmaier and E. C. Jones. The works and main systems of both the old companies will be connected, and a series of proposed improvements include an extension of the main lines

wherever and whenever the demands require. It is announced that there is to be no advance in the selling rate, but that Wilkes-Barre will continue to have dollar gas. General Manager Flanigan is determined to popularize the new corporation in every possible way, and the public will have no reason to regret the consolidation. The new Company will hereafter operate both of the old companies under a lease of 99 years. The Directors of the Wilkes-Barre Gas Company have resigned, and the following officers were chosen to replace them: President, J. W. Hollenback; Vice-President, Abram Nesbitt; Directors, J. W. Hollenback, Abram Nesbitt, E. W. Mulligan, Liddon Flick, John Flanigan, Joseph Birkbeck and E. H. Jones."

A CORRESPONDENT at Winnipeg, Manitoba, writing under date of July 1st, says: "It is well settled that the proprietors (or some of them) of the Manitoba Gas Light Company have secured control of the Northwest Electric Light Company, of Winnipeg, and that both concerns will hereafter work in harmony."

IT is said that W. F. Ross, of Rochester, N. Y., has petitioned the authorities of Rennselaer, N. Y., for the right to construct and operate a gas works in that place. He proposes to furnish gas for illumination at the rate of $1.25 per 1,000 cubic feet, the charge for a fuel use to be $1 per 1,000. The Law Committee of the Board of Aldermen is considering the matter.

JOHN B. BIGELL has been appointed gas maker to the proprietors of the Doylestown (Pa.) Gas Company, vice Frank Heiser, resigned.

"T. R. W." is informed that the annual meeting of the Oswego (N. Y.) Gas Light Company will be held at 4 P.M. of next Wednesday.

IT is said that Topeka, Kansas, capitalists propose to establish a gas works in McPherson, Kansas. The place seems to us to be rather a small one for such an enterprise.

AT the hearing before the Board of Gas and Electric Light Commissioners, on the petition of the Milford (Mass.) Electric Light and Power Company, to issue certain amounts of new stock and bonds, no one in remonstrance was heard. The Commissioners took the matter under advisement.

IT is said that 50 is bid for the new common stock of the Pittsburg (Pa.) Consolidated Gas Companies.

THOSE interested in the development of the carbide of calcium trade have, as a rule, been persistent in their understatement of the cost of that material, wherefore it is interesting to have from interested parties a clear admission that carbide of calcium comes high. We think this admission is easily made in the pamphlet recently issued by the "Acetylene Illuminating Company, Limited," whose manufacturing plant is located at the Falls of Foyers, Scotland, and whose "Head office" is "63 Queen Victoria street, London." In the pamphlet we find these statements:

"Carbide of calcium cannot be manufactured economically on a small scale. The Acetylene Illuminating Company have made arrangements to extend the present plant at Foyers to meet the increasing demands, and have taken steps by which they control ample water power with cheap raw materials and facilities for transport both by water and rail to deal with the future requirements of the industry, so that, apart from the protection offered by patents, the Company will be well secured against successful competition.

"Much misconception exists, and many unwarrantable statements have been made, as to the cost of manufacturing carbide of calcium. The experience of the Acetylene Illuminating Company shows that both at home and abroad this cost is much higher than was expected in the early stages of the experiments, if, as in this Company's case, every precaution be taken to secure a product of the highest quality. Provided the generating apparatus is good, and does not waste the gas, the value of carbide is considerably over £30 per ton to the consumer, who would be willing to pay 5s. per 1,000 cubic feet for 16-candle coal gas. The *wholesale* price of carbide as at present quoted by this Company is £20 per ton at Foyers, special terms being made to the trade for important contracts. The price delivered in small lots to the consumer may vary from 25s. to 30s. per cwt. These prices may be reduced when working on a large scale. Every precaution is taken by the Acetylene Illuminating Company to send out carbide, giving an average of 5 cubic feet per pound, but the large ingots are necessarily richer in gas in some places than in others, some portions giving over 5.5 cubic feet of gas per pound, whilst others may only give 4.5 cubic feet. The cleaned ingot is carefully broken up by hand, the richer is then separated from the poorer portions, crushed by machinery and riddled so as to avoid packing dust! The rich and relatively poorer qualities are then mixed together in order to get an average of 5 cubic feet. It may happen that a user will get a few pieces giving off a smaller proportion of gas, but the Acetylene Illuminating Company from the necessities of the case, are only able to guarantee the average. * * * It is not expected that acetylene gas will compete with coal gas or electric lighting, but there is an enormous field for it in the lighting of country houses, churches, factories, small villages and railway stations, where neither coal gas nor electricity is available. Besides the above, there are numerous other possible uses, such as for floating buoys, gas engines, motor cars, railway carriage lighting, train cars and omnibuses, either alone or as a diluent with other gases. There is also a considerable field for it in bicycle lamps, table lamps, magic lanterns and photography."

THE above extracts, it should be borne in mind, are from the display story point of view of a Company engaged in the manufacture of the "finished material."

SUPERINTENDENT ROSS, in charge of the American Gas Company's recent purchase at Rye and Portchester, N. Y., is busily engaged in overhauling the plant. When the improvements are completed the residents of Rye and Portchester will for the first time in the history of those places know and appreciate what good service from a central lighting station really means.

THE proprietors of the Flushing (L. I.) Gas and Electric Light Company have announced that hereafter the selling rate is to rule at $1.25 per 1,000 cubic feet.

THE New Bedford (Mass.) Gas and Edison Light Company have declared a regular quarterly dividend of 1½ per cent., payable the 15th inst.

THE Merchantville (N. J.) Light, Heat and Power Company has been reorganized. It is further understood that the gas plant is to be moved to Wellwood, thus unifying the gas and electric stations of the districts named.

THE new generating plant of the Macomb (Ills.) Electric Light and Gas Company, which was erected by the Western Gas Construction Company, of Fort Wayne, Ind., is in satisfactory operation.

THE Wm. M. Crane Company, of New York city, was incorporated July 1st. It succeeds to the business of William M. Crane & Co., and to the goodwill and foundry plant of the Peekskill (N.Y.) Stove Works, which means that the Crane folks now have ample plant facilities for the making of gas stoves on their own account from bottom to top.

THE hearing before the Massachusetts Board of Gas and Electric Light Commissioners, respecting the application of the Massachusetts Pipe Line Company for the right to issue $1,000,000 of capital stock, is underway. At the initial hearing some pretty tall estimating on the cost of the apparatus necessary for the work contemplated was presented, but as our report of the figures presented is not sufficiently well verified, we will await "Observer's" forwarding of the same. Meanwhile we may repeat that the figures we have on hand are away on the high side.

THE projectors of the opposition Company for Denver, Col., have arranged a scale or schedule of selling rates which would be simply impossible to carry out for any length of time and have life left in the concern. The proposed schedule is: For an illuminating supply, 80 cents per 1,000 cubic feet; for a fuel supply, 50 cents per 1,000 cubic feet; for a supply on both accounts, 65 cents per 1,000 cubic feet. Indeed, the schedule is simply ridiculous.

THE annual meeting of the Municipal Gas Company, of Albany, N. Y., will be held at noon of the 19th inst.

MR. GEORGE L. LAUFER, General Manager of the Pennsylvania Drop Forge Company, died on the 25th ult. Deceased, who was in his 45th year, was widely and well known in the drop forging trade.

LATER information regarding the proposed "cheap gas" opposition Company for Denver, Col., is to the effect that it is to be known as the Mutual Gas Company, and that ex-Governor J. A. Cooper, T. F. Dunaway, Charles Wheeler, F. A. Bailey and William Ridley, are on its Board of Directors. Its "initial" capital is put at $100,000.

THE gas supply of the Island of Cuba is woefully demoralized.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

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MONDAY, JULY 11, 1898.

## New Use for the Rontgen Rays.

*Engineering* says that in a note recently communicated to the Paris Académie des Sciences, M. H. Couriot suggests a novel use for the X-rays. Professor Röntgen's discovery has already proved of great service in surgery, but M. Couriot suggests that the rays may prove as efficient in showing the intimate structure or siliceous skeleton of our coals as they are in defining the calcareous skeletons of animals. He states that by means of a powerful Crookes tube and a fluorescent screen it is easy to determine the purity of a fuel. Carbon in all its forms is exceedingly transparent to the rays, whilst silica and silicates are opaque; and on placing a lump of coal between the tube and the screen, all the intimate details of the slag and clinker forming portions of the fuel at once appear. M. Couriot has tested in this way anthracite, coal, lignite, peat, coke and block fuel.

The finest particles of silicate, though quite invisible to the eye, show up at once on the screen as dark spots or bands upon a bright ground. The differences in the quality of a series of coals can be traced step by step, showing at once the variations in the purity of the fuel. The conglomerate structure of block fuel is clearly exhibited, whilst with coke the particles of iron sulphide are indicated by black spots on the fluorescent image. Carbon is so transparent that it is unnecessary that the samples should be regular blocks, as rough lumps, the sides of which usually follow the natural planes of cleavage of the coal, serve perfectly well. M. Couriot has taken radiographs with specimens 1½ inches to 2 inches thick, the coil used having a spark 10 inches long and the exposure being five minutes.

## The Market for Gas Securities.

Dullness and firmness were the prevailing characteristics of the market for city gas shares last week. Consolidated was quoted at noon to-day (Friday) at 198 bid. There was no animation, however, in the trading. Other city shares are in small demand, but prices are well maintained, which statement applies especially to New Amsterdam and Standard shares. Close observers predict a sharp upward movement in Consolidated and Standard common.

Brooklyn Union shows no change. Peoples, of Chicago, crossed par again to-day. The short interest in this stock seems to be having a hard time of it. Bay State is still in the dumps, Lacledes are weaker, and Baltimore Consolidated is firmly held.

## Gas Stocks.

**Quotations by Frederic R. Cochran & Co., Brokers and Dealers in Gas Stocks,**
20 AND 22 BROAD STREET, NEW YORK CITY.
JULY 11.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

| *N. Y. City Companies.* | *Capital.* | *Par.* | *Bid.* | *Asked.* |
|---|---|---|---|---|
| Consolidated | $36,230,000 | 100 | 198 | 199 |
| Central | 500,000 | 50 | | .. |
| " Scrip | 220,000 | .. | 100 | . |
| Cental Union, Bonds, 5's | 3,000,000 | 1,000 | 99½ | 100 |
| Equitable | 4,000,000 | 100 | 206 | 215 |
| Bonds, 6's | 1,000,000 | 1,000 | 105 | .. |
| " 1st Con. 5's | 2,300,000 | 1,000 | 114 | . |
| Metropolitan Bonds | 658,000 | .. | 108 | 112 |
| Mutual | 500,000 | 100 | 325 | 335 |
| " Bonds | 1,500,000 | 1,000 | 100 | 102 |
| Municipal Bonds | 750,000 | . | .. | |
| New Amsterdam Gas Co. | 13,000,000 | 100 | 31 | 31⅜ |
| Preferred | 10,000,000 | 100 | 75 | 76 |
| Bonds, 5's | 11,000,000 | 1,000 | 102 | 103 |
| Northern | 150,000 | 50 | | |
| " Bonds | 150,000 | 1,000 | .. | |
| Northern Union, Bonds, 5's | 1,250,000 | 1,000 | 94½ | 95½ |
| New York and East River | 5,000,000 | 100 | 81 | 84 |
| Preferred | 2,000,000 | 100 | 112 | 115 |
| Bonds 1st 5's | 3,500,000 | 1,000 | 110 | 112 |
| " 1st Con. 5's | 1,500,000 | | 105 | 107 |
| Richmond Co., S. I. | 348,650 | 50 | 70 | .. |
| " Bonds | 100,000 | 1,000 | .. | .. |
| Standard | 5,000,000 | 100 | 138 | 140 |
| Preferred | 5,000,000 | 100 | 153 | 160 |
| Bonds, 1st Mortgage, 5's | 1,500,000 | 1,000 | 112 | 114 |
| Yonkers | 299,65 | 500 | 130 | |
| *Out-of-Town Companies.* | | | | |
| Brooklyn Union | 15,000,000 | 100 | 122 | 124 |
| " " Bonds (5's) | 15 000,000 | 1,000 | 115 | 115½ |
| Bay State | 50,000,000 | 50 | 3½ | 3¾ |
| " Income Bonds | 2,000,000 | 1,000 | .. | 75 |
| Boston United Gas Co.— | | | | |
| 1s Series S. F. Trust | 7,000,000 | 1,000 | .. | 92 |
| 2d " " " | 3,000,000 | 1,000 | 70 | .. |
| Buffalo City Gas Co. | 7,000,000 | 100 | 24¼ | 25 |
| " " Bonds, 5's | 7,000,000 | 1,000 | 94 | 95 |
| Central, San Francisco | 2,000,000 | .. | 95 | .. |
| Chicago Gas Co. Guaranteed Gold Bonds | 7,650,000 | 1,000 | 104 | 104¼ |
| Columbus | 1,069,000 | . | 89 | 91 |
| 1st Mortgage | 1,085,000 | .. | 101 | 103½ |
| Consumers, Jersey City | 2,000,000 | 100 | 75 | 80 |
| " Bonds | 600,000 | 1,000 | 100 | 103¾ |
| Cincinnati G. & C. Co. | 8,500,000 | 100 | 201 | 202 |
| Consumers, Toronto | 1,800,000 | 50 | 184½ | 187 |
| Capital, Sacramento | 500,000 | 50 | .. | 35 |
| Bonds (6's) | 150,000 | 1,000 | .. | .. |
| Consolidated, Baltimore | 11,000,000 | 100 | 64 | 64⅛ |
| Mortgage, 6's | 3,000,000 | .. | 107 | 107½ |
| Chesapeake, 1st 6's | 1,000,000 | .. | .. | .. |
| Equitable, 1st 6's | 910,000 | .. | .. | .. |
| Consolidated, 1st 5's | 1,490 000 | .. | .. | .. |
| Consolidated G. & E. Co.'s, Little Falls, N.Y. | 90,000 | 100 | .. | 100 |
| Bonds | 75,000 | .. | .. | 100 |
| Detroit | 4,000,000 | | 58 | 58½ |
| " Con. Bonds | 4,312,000 | .. | 96½ | 98 |
| Equitable Gas & Fuel Co., Chicago, Bonds | 2,000,000 | 1,000 | .. | 101 |
| Fort Wayne | 2,000,000 | .. | 75 | 80 |
| " Bonds | 2,000,000 | .. | 88 | 91 |
| Hartford | 750,000 | 25 | .. | 145 |
| Indianapolis | 2,000,000 | .. | 115 | 125 |
| " Bonds, 6's | 2 650,000 | .. | 106 | 107 |
| Jersey City | 750,000 | 20 | 180 | .. |
| Lafayette Gas Co., Ind. | 1,000,000 | 100 | 78 | 83 |
| Bonds | 1,000,000 | 1,000 | 90 | 91 |
| Louisville | 2,570,000 | 50 | . | .. |
| Laclede, St. Louis | 7,500,000 | 100 | 50 | 50¾ |
| Preferred | 2,500,000 | 100 | 90 | 92 |
| Bonds | 9,034,400 | 1,000 | 104 | 105 |
| Montreal, Canada | 2,000,000 | 100 | 200 | .. |
| Newark, N. J., Gas Co. | 1,000,000 | .. | 200 | 220 |
| Bonds, 6's | 4,000,000 | .. | 128 | 130x |
| New Haven | 1,000,000 | 25 | 252 | .. |
| Oakland, Cal. | 2,000,000 | .. | 53½ | 54 |
| " Bonds | 750,000 | .. | .. | .. |
| Peoples G. L. & Coke Co., of Chicago | 25,000,000 | 100 | 100 | 100⅛ |
| Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage | 20,100,00 | 1,000 | .. | 108 |
| 2d " | 2,500,000 | 1,000 | 104 | 105 |
| Peoples, Jersey City | 500,000 | 50 | .. | 175 |
| Rochester Gas & Elec. Co. | 2,150,000 | 50 | .. | .. |
| Preferred | 2,150,000 | 50 | 83 | .. |
| Consolidated 5's | 2,000,000 | .. | 87½ | 90 |
| San Francisco, Cal. | 10,000,000 | 100 | 94 | 94½ |
| St. Paul Gas Light Co. | 1,500,000 | 100 | 49 | 51 |
| 1st Mortgage 6's | 650,000 | .. | 84 | 87 |
| Extension, 6's | 600,000 | .. | .. | .. |
| General Mortgage, 5's | 2,400,000 | . | 88 | 90 |
| Syracuse, N. Y. | 2,500.000 | 25 | 17 | 18 |
| Bonds | 1,000 000 | | 94 | 97 |
| Washington, D. C | 2,000,000 | 20 | 250 | |
| Western, Milwaukee | 4,000,000 | 100 | 88 | 90 |
| Bonds, 5's | 3,556,000 | . | 102 | 104 |
| Wilmington, Del. | 550.000 | 50 | 200 | |

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## DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., 813 DREXEL BUILDING, PHILA., PA., June 23, 1898.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable on July 15, 1898, to stockholders of record at the close of business June 30, 1898. Checks will be mailed.

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## WANTED,

A capable young man of pleasant address

**To Sell Gas Stoves, Heaters, Welsbach Lamps, etc.**

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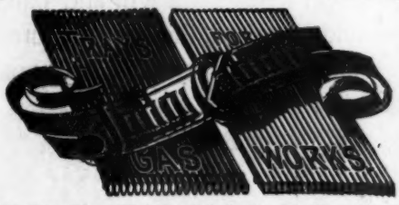


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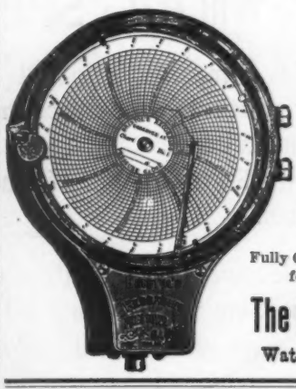

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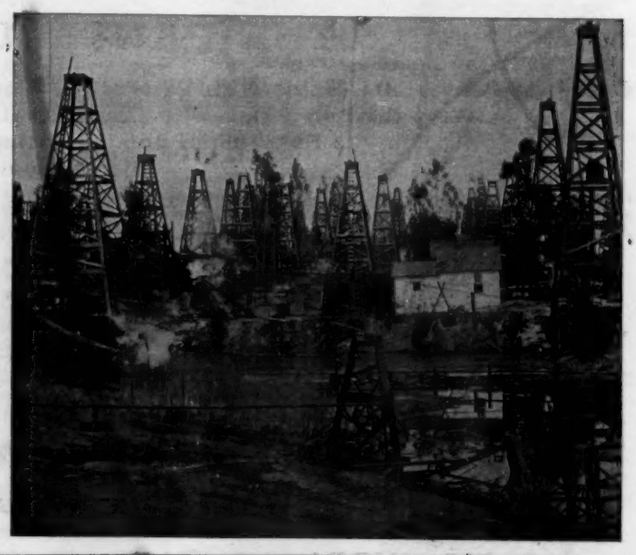

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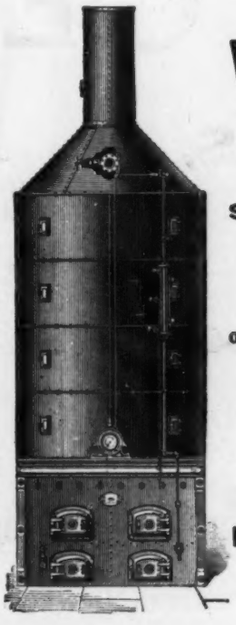

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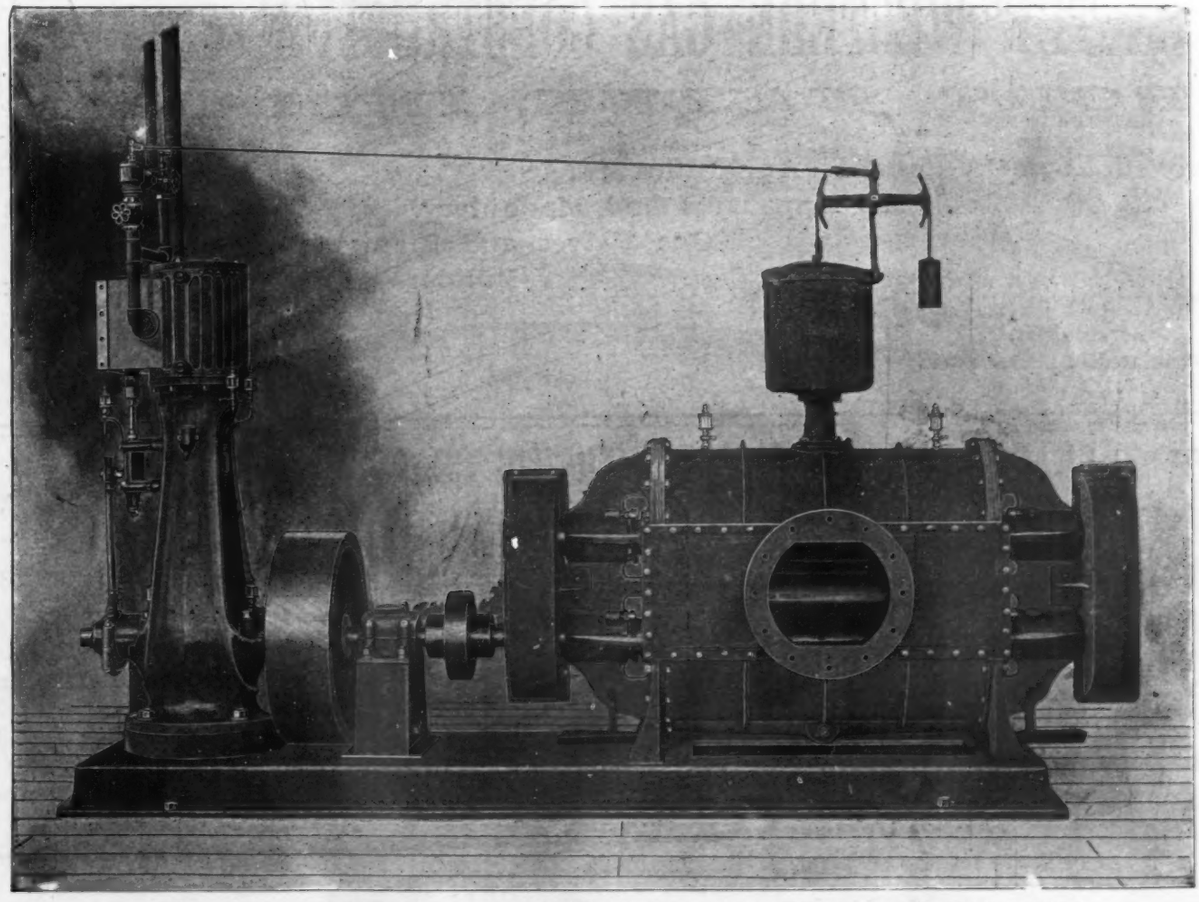

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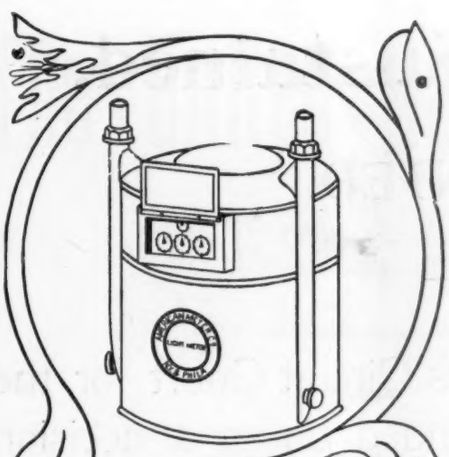

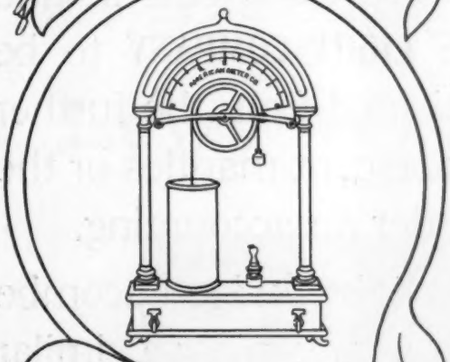

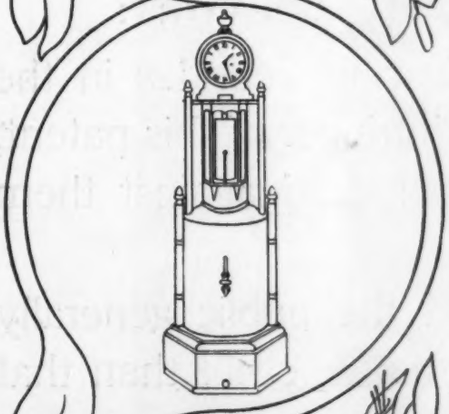

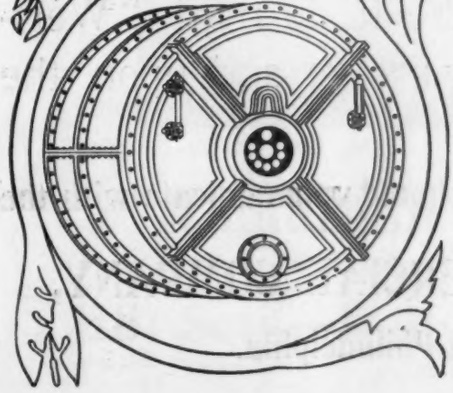

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**NEW YORK AND PHILADELPHIA,**

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**SAN FRANCISCO.**

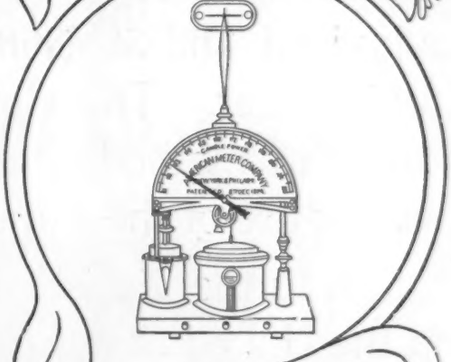
## PUBLIC LIGHTING TABLE.

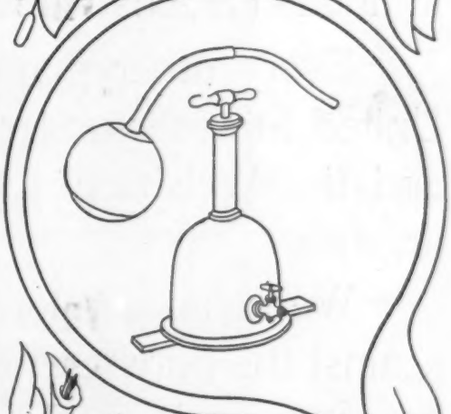
### JULY, 1898.

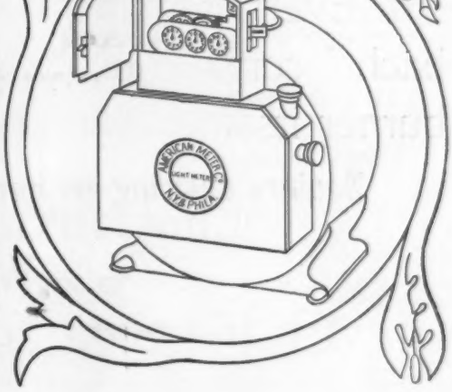
| Day of Week. | Table No. 1. Following the Moon. Date. | Light. | Extinguish. | Table No. 2. New York City. All Night Lighting. Light. | Extinguish. |
|---|---|---|---|---|---|
| | | | | P.M. | A.M. |
| Fri. | 1 | 1.50 AM | 3.30 AM | 7.30 | 3.15 |
| Sat. | 2 | No L. | No L. | 7.30 | 3.15 |
| Sun. | 3 | No L. FM | No L. | 7.30 | 3.15 |
| Mon. | 4 | No L. | No L. | 7.30 | 3.15 |
| Tue. | 5 | 8.00 PM | 10.00 PM | 7.30 | 3.15 |
| Wed. | 6 | 8.00 | 10.30 | 7.30 | 3.15 |
| Thu. | 7 | 8.00 | 11.00 | 7.30 | 3.15 |
| Fri. | 8 | 8.00 | 11.20 | 7.30 | 3.15 |
| Sat. | 9 | 8.00 | 11.50 | 7.30 | 3.15 |
| Sun. | 10 | 8.00 LQ | 12.10 AM | 7.30 | 3.15 |
| Mon. | 11 | 8.00 | 12.40 | 7.30 | 3.15 |
| Tue. | 12 | 8.00 | 1.20 | 7.30 | 3.15 |
| Wed. | 13 | 8.00 | 2.00 | 7.30 | 3.15 |
| Thu. | 14 | 8.00 | 2.40 | 7.30 | 3.15 |
| Fri. | 15 | 8.00 | 3.40 | 7.30 | 3.15 |
| Sat. | 16 | 8.00 | 3.40 | 7.20 | 3.15 |
| Sun. | 17 | 7.50 | 3.50 | 7.20 | 3.15 |
| Mon. | 18 | 7.50 NM | 3.50 | 7.20 | 3.15 |
| Tue. | 19 | 7.50 | 3.50 | 7.20 | 3.15 |
| Wed. | 20 | 7.50 | 3.50 | 7.20 | 3.15 |
| Thu. | 21 | 7.50 | 3.50 | 7.20 | 3.15 |
| Fri. | 22 | 7.50 | 3.50 | 7.20 | 3.15 |
| Sat. | 23 | 8.30 | 3.50 | 7.20 | 3.15 |
| Sun. | 24 | 9.00 | 3.50 | 7.20 | 3.15 |
| Mon. | 25 | 9.30 | 3.50 | 7.20 | 3.15 |
| Tue. | 26 | 10.00 FQ | 3.50 | 7.20 | 3.15 |
| Wed. | 27 | 10.40 | 3.50 | 7.20 | 3.15 |
| Thu. | 28 | 11.30 | 3.50 | 7.20 | 3.15 |
| Fri. | 29 | 12.40 AM | 3.50 | 7.20 | 3.15 |
| Sat. | 30 | 1.50 | 3.50 | 7.10 | 3.30 |
| Sun. | 31 | No L. | No L. | 7.10 | 3.30 |

### TOTAL HOURS LIGHTING DURING 1898.

| By Table No. 1. | Hrs. Min. | By Table No. 2. | Hrs. Min. |
|---|---|---|---|
| January | 210.40 | January | 423.20 |
| February | 186.40 | February | 355.25 |
| March | 181.20 | March | 355.35 |
| April | 166.10 | April | 298.50 |
| May | 156.40 | May | 264.50 |
| June | 144.30 | June | 234.25 |
| July | 147.30 | July | 243.45 |
| August | 157.10 | August | 280.25 |
| September | 169.50 | September | 321.15 |
| October | 186.00 | October | 374.30 |
| November | 204.30 | November | 401.40 |
| December | 218.30 | December | 433.45 |
| Total, yr. | 2129.30 | Total, yr. | 3987.45 |







# Welsbach Patent Sustained.

## INJUNCTION GRANTED.

Judge Townsend, in the United States Circuit Court for the Southern District of New York, has handed down a decision sustaining the Welsbach Light Company's Rawson patent, and adjudged **THE SUNLIGHT INCANDESCENT GAS LIGHT COMPANY** to be an infringer. This Company has been enjoined from the further use of its method of manufacture of incandescent mantles or the sale or use of the same, and ordered to render an accounting.

A further decision has been handed down by Judge Lacombe in the United States Circuit Court, granting a motion for a similar injunction against **THE REX INCANDESCENT LIGHT COMPANY.**

Every other manufacturer of incandescent mantles in the United States is under these decisions an infringer of this patent, and the Welsbach Light Company will proceed against them at once.

We again caution gas companies and the public generally against the purchase of any incandescent mantle other than that made and sold by the Welsbach Light Company or its agents.

Every genuine Welsbach lamp has the trade mark "Welsbach" conspicuously printed upon the package and upon the burner itself.

**Dealers desiring to handle the genuine article should communicate with the**

**WELSBACH COMMERCIAL COMPANY,**

**Drexel Building, Philadelphia.**

# The United Gas Improvement Company,

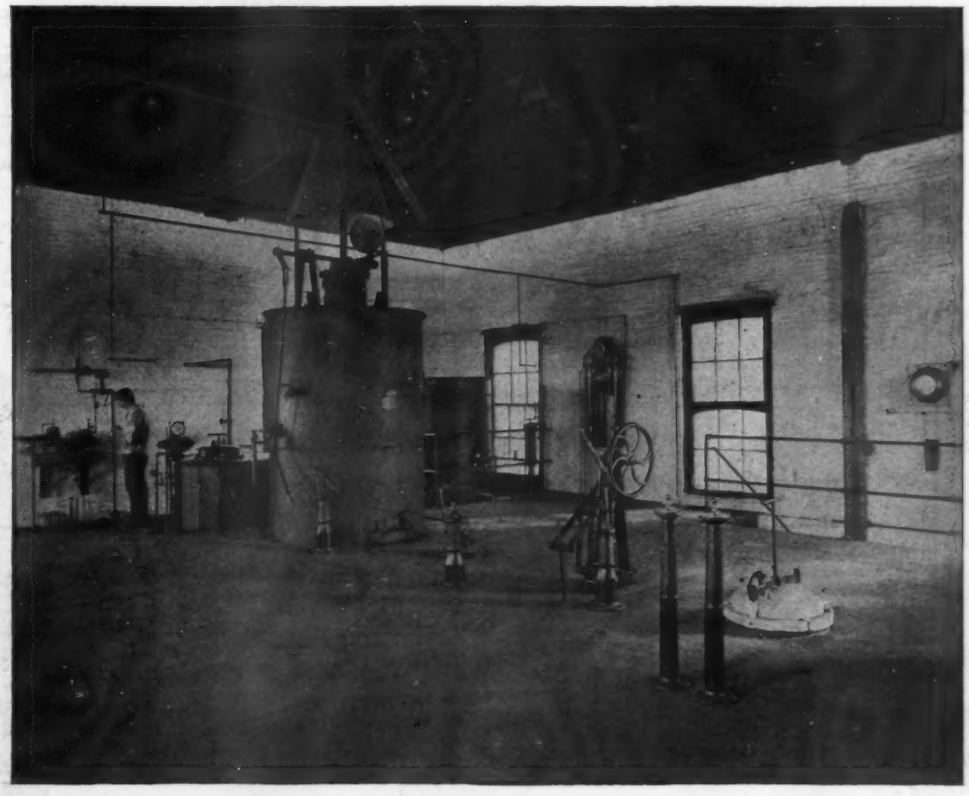
DREXEL BUILDING, PHILA., PA.

---

**The Standard Junior,**

**The Standard Double Superheater,**

## LOWE WATER GAS APPARATUS.



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**281 Sets—Daily Capacity, 179,850,000 Cu. Ft.**

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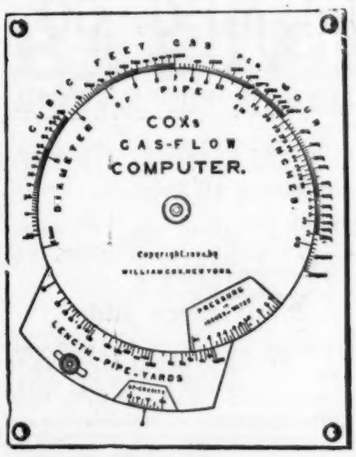


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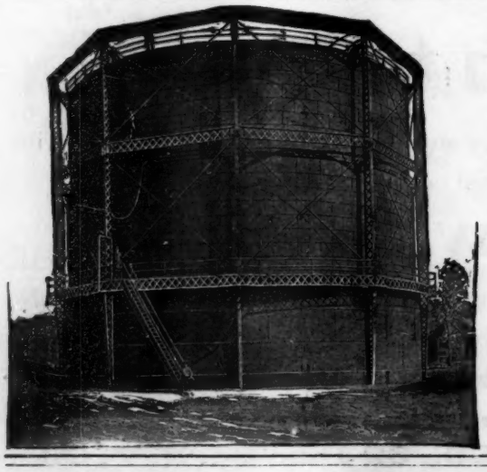

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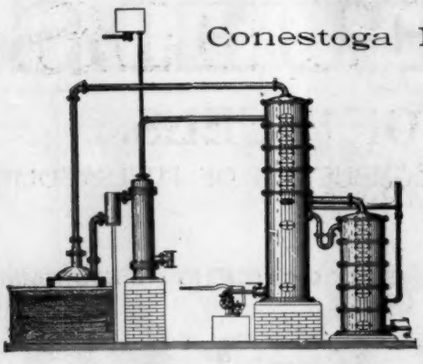

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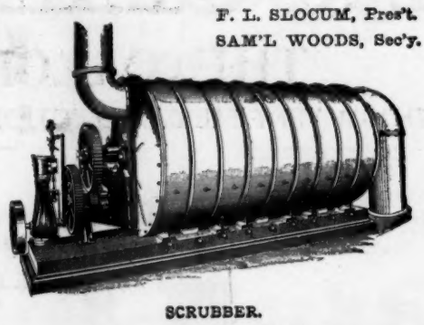

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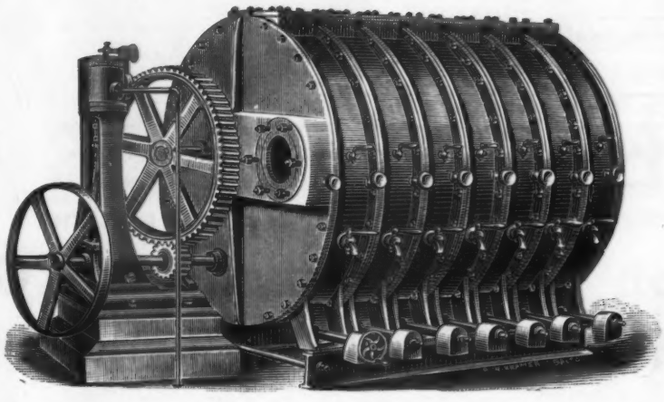

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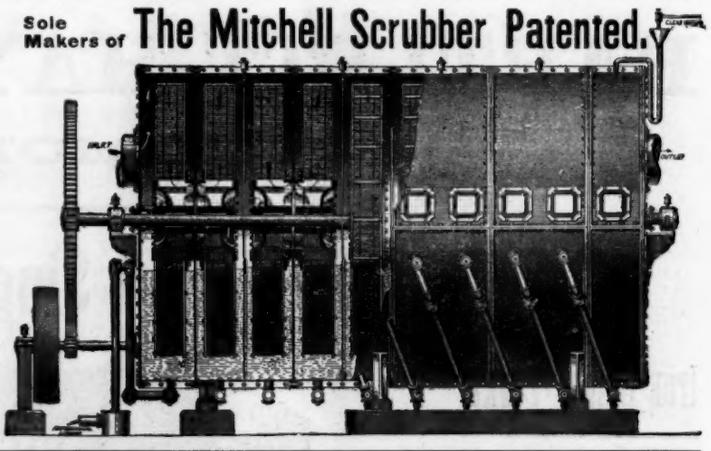

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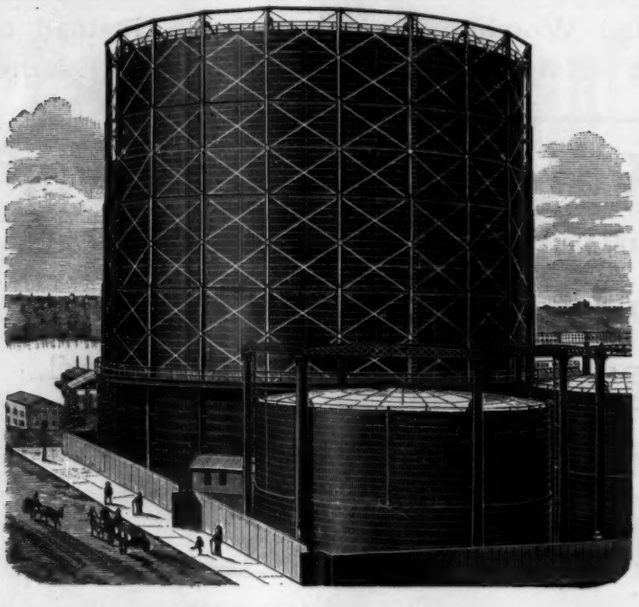

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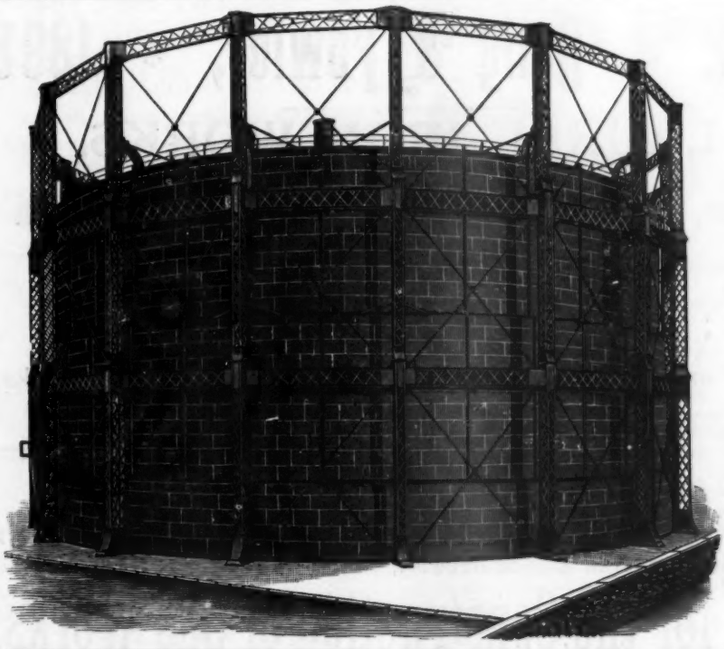

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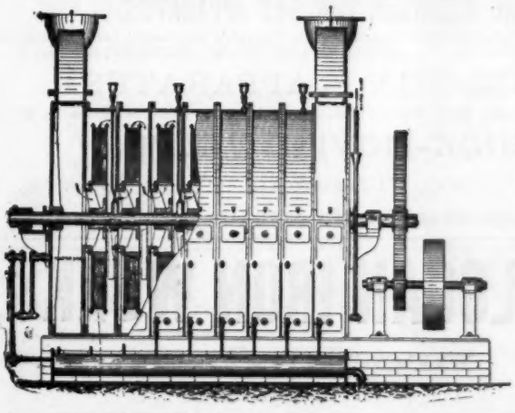

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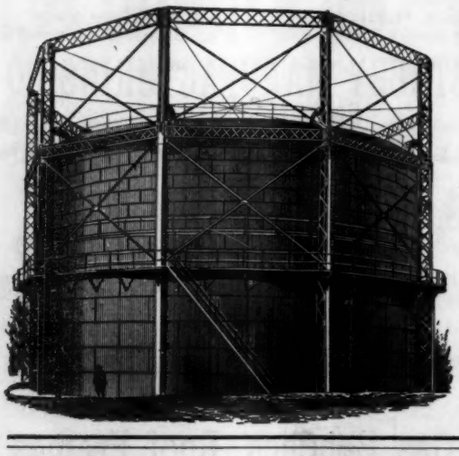

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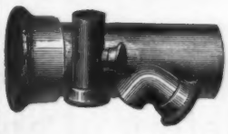
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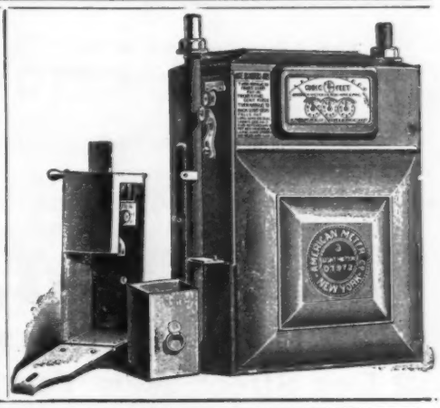

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An Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland. Being the Twenty-eighth Year of Publication. Compiled and Arranged by

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